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# WILDLIFE AND LAND USE PLANNING
# WITH PARTICULAR REFERENCE TO COASTAL COUNTIES

*Frank B. Barick, Chief*

*and*

*T. Stuart Critcher, Assistant Chief*

**Intergency Wildlife Coordination Section**

NORTH CAROLINA WILDLIFE RESOURCES COMMISSION
RALEIGH, NORTH CAROLINA

April 1975

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## PREFACE

This publication was prepared to provide an overview of the relationships between land use and wildlife. It was intended for use by those involved with the land use planning process pursuant to legislation mandating such effort in North Carolina.

Virtually all lands produce wildlife, but the kinds and amounts are largely determined by the nature of the land and how it is used by man. Admittedly, there do exist some conflicts between land use and wildlife conservation, but the production and utilization of wildlife resources are compatible with most forms of land use. While it may become appropriate, at times, to dedicate particular land areas to the preservation of particular (endangered) species, exclusive dedication of land to conservation of wildlife is the exception rather than the rule.

Maximizing wildlife production is a highly complex matter that cannot be reduced to a few simple formulas. Although this publication provides some insight of wildlife values, characteristics and needs as they relate to land use, it was not intended as a handbook of instructions for dealing with specific problems. While the suggestions contained herein will help to conserve wildlife in the allocation of land use priorities, specific problems should be referred for study by professionally trained wildlife biologists.

There appears to be considerable promise that new technologies based on ERTS and other satelite imagery may, in the near future, provide a practical means of land inventory that will yield hitherto unattainable detailed information on the extent and spatial distribution of wildlife habitats. This should substantially expedite the evaluation of land use potentials and selection of alternatives designed to maintain and enhance the quality of life. Hopefully, subsequent editions of this publication will be geared to this new advance in mapping technology.

## WILDLIFE AND LAND USE PLANNING

## WITH PARTICULAR REFERENCE TO COASTAL COUNTIES


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## SUMMARY AND IMPLEMENTATION

The environmental needs of wildlife are very similar to those of man. Contamination of air, water or food to such an extent as to cause the death of fish and game can also cause the death of man. Preservation of wild creatures, through maintenance of their required habitats, contributes to the welfare of humanity through economic, therapeutic, aesthetic and recreational values.

Wildlife is a product of the land and its abundance is governed by land use practices. Land can be used for production of food and fiber as well as for residential and industrial purposes in such manner as to encourage simultaneous occupancy by wildlife. Land use practices deleterious to wildlife are frequently deleterious to man. Modification of such practices to favor wildlife will also favor survivability and quality of life for man.

In the interest of long term human survival, we need to place more emphasis on principles of land stewardship and less on immediate monetary return. We, the present generation, are here for only a minute fraction of eternity. Countless generations were here before us and hopefully countless more will follow. The legacy of a profit-plundered planet would be the worst condemnation of our generation.

The means for accomplishing environmental preservation are at hand. Research can help to separate the bad from the good, and for developing more of the good. Land use planning provides a procedure for identifying environmentally sound alternatives for land use. Public acceptance of desirable alternatives can be expedited through open forums and supportive news media. Legislation, regulation (zoning) and taxation are the final tools of implementation.

In the allocation of specific land areas to particular uses the interests of wildlife conservation may be safeguarded or even enhanced if certain principles are observed. These considerations are briefly discussed below as they relate to major land uses and to each of the major land uses classes developed by the State Department of Administration, Office of State Planning.

**Developed, Transition and Community Areas**

Wildlife on lands dedicated to these uses is largely confined to those forms that provide recreation through observation rather than through hunting and fishing. Many species of songbirds can be attracted to Developed, Transition and Community areas if nesting sites in the form of trees and shrubs are provided. Even small game such as squirrel, rabbit, opossum and quail take up residence in and about urban areas if they can find proper habitat conditions. Wildlife can be attracted to such areas if development plans include a good mix of both evergreen and deciduous vegetation along streets, and if parks, small or large, are scattered throughout larger communities.

Cluster development of residential areas is highly conducive to urban forms of wildlife since it provides for retention of trees and native vegetation between the clusters. Similarly, if industry is concentrated in industrial parks adjoining urban areas, their grounds can be made very attractive for songbirds and small game. Industries requiring buffer zones can, at little cost, develop such zones to be attractive to wildlife. New industries should be carefully screened on the basis of the nature of their waste products as they might relate to environmental degradation, the availability of methodology to dispose of them in an environmentally appropriate manner, and the willingness of the firms to do so.

Streams and floodways through Developed, Transition or Community areas should be restricted from development and retained in a natural state to facilitate exercise of their natural function--movement of water. Such sites make ideal locations for municipal parks and greenways. They also offer opportunities to create ponds or lakes for boating and fishing. Such impoundments can also be very attractive to shorebirds, waterfowl, muskrat, raccoon and mink, thereby adding a special dimension of enjoyment for those whose wildlife observation is restricted to the urban environment. Swamps bordering developed areas provide a special opportunity for outdoor recreation with nature trails to enhance observation of the native flora and fauna.

One of the major environment-impacting influences of Developed land areas is disposal of waste products. Improperly handled, they can have seriously adverse effects upon wildlife resources. Discharge

of industrial wastes into streams can kill fish or render them unpalatable. Excessive amounts of sewage can result in oxygen depletion of streams and rivers. Land disposal of garbage and other waste can result in similar contamination of streams through leaching. Of equal or greater significance is the degradation of streams through siltation from inadequately controlled erosion from building sites and road construction. Community planners and local officials can have a strong influence in preventing and correcting these abuses by helping to implement recently enacted erosion and effluent standards and by encouraging recycling of waste materials rather than disposal.

**Rural Areas**

The Rural category includes farm land and timber producing woodlands, which together occupy about 90 percent of the State's land area. Lands falling into this use category constitute the bulk of wildlife habitat in North Carolina.

Most of the hunting and fishing in North Carolina is done on these lands with the balance being done on lands falling into the Conservation category.

The use of rural lands for the recreational pursuit of wildlife contributes substantially to the health and well being of our citizenry. This is an increasingly important dimension of land use that is often overlooked. Few landowners are compensated for such use of their land and they are in effect, contributing a valuable public service by allowing their lands to be used for this purpose. This contribution to the public welfare should be recognized in establishment of tax rates on rural lands.

The wildlife producing capacity of rural lands, both agricultural and timbered, can be enhanced substantially by certain land use practices. Lands managed to favor wildlife productivity are deserving of tax reduction considerations.

Forest practices that enhance wildlife production include:

-limitation of clear-cuts to 50-acre units

-maintenance of a wide diversity of age classes

-retention of hardwoods along streams and on other hardwood sites

- control of soil erosion in the course of timber harvest

-establishment of food and cover plantings for wildlife.

Agricultural land use practices that enhance wildlife production include:

-prevention of soil erosion with sod waterways, sod planting, stubble mulching, terracing, contour plowing, etc.

-retention of ditch bank cover by mowing in alternate years rather than annually

-breaking the monotony of huge monocultures with windbreak "conservation" strips containing natural vegetation

-use of biodegradable insecticides that do not have adverse secondary impacts upon nontarget species, and use of biological and cultural pest controls as they are developed

-planting wildlife food and cover patches in odd corners not amenable to crop production

Lands that are highly productive of farm or forest crops also have the capacity to produce abundant wildlife. It is, therefore, important to maintain the integrity of such lands for the sake of wildlife production as well as for the sake of agricultural and timber crop production. Urban and industrial development as well as highway construction, should be so planned as to minimize inpingement on such lands.

**Conservation Lands**

While relatively limited in extent, lands in the Conservation category produce some of the highest concentrations of wildlife. Estuarine and wetland areas support the major portion of our waterfowl populations. Wooded swamps and riverine lowlands support some of our best deer and wild turkey populations. Extensive, remote timbered areas provide the last hope for our diminishing bear population. Endangered species such as the eagle, osprey and alligator are largely restricted to such lands.

In that the conservation classification implies some restriction in use of lands, particularly where they are further designated as areas of environmental concern under mandate of the Coastal Area Management Act, tax rates should provide a measure of compensation. Such action is further justified on the basis of wildlife production and its use by the public, even if such use is restricted to observation.

Forested conservation lands should be retained in forest cover that reflects the natural ecology and should not be converted to short rotation industrial pine production. This not only retains its natural integrity but probably also constitutes its most productive use. Management and harvest of timber on such areas are not detrimental to wildlife production if clear-cuts are restricted in area and a wide diversity of age classes is allowed to develop.

Hardwood swamps are especially valuable to many forms of wildlife. In addition, the type of timber peculiar to them is highly valuable to our furniture industry. They also serve as detention reservoirs to reduce the impact of floods on downstream communities and at the same time, replenish underground aquifers. They can also serve to purify and filter waste water. These reasons alone should be adequate to justify their preservation and to preclude their destruction through channelization or reservoir construction.

Protection of estuarine areas is particularly important to wildlife. Two practices are recommended to retain their integrity and to enhance their productivity in consonance with human use. One of these has to do with the continuing, and perhaps increasing, requests for authorization to dig channels through marshland to get to open water. While each of these channels constitutes only a minor diminution of marsh, their accumulated impact adversely affects thousands of acres of wildlife habitat. A better approach might be to construct a channel along the shoreline with canals to the open water at quarter or half-mile intervals. Such a system could be appropriately done at public expense, possibly by the Corps of Engineers, and maintained for public use.

A second practice that would considerably enhance production of waterfowl, shore birds, wading birds, at least two species of fish, and blue crabs, would be the impoundment of needlerush marsh. Such marshes contribute at a lower rate to estuarine enrichment than do the *Spartina* marshes. It is possible that their contribution could actually be enhanced through the periodic flushing that is required in management of flooded marsh. A study[11] sponsored by the Water Resources Institute indicates that impoundment of needlerush marsh provides much more effective control of salt marsh mosquitoes than

ditching. This practice should be studied further to determine its effect on productivity of adjacent estuarine waters.

**Transportation Routes**

The placement, design and maintenance of highways, power lines, gas lines, water and sewer lines can have a strong influence on wildlife productivity.

As a general rule, the interests of wildlife conservation are best served if new highways follow existing routes rather than further fragment our fast diminishing wilderness areas.

Design of federal highways has been upgraded so that they are usually pleasing in appearance and the rights-of-way are well stabilized with little or no erosion of soil. Unfortunately, the same cannot be said of rural roads. "State" and "county" roads traverse some of our most attractive scenery only to be marred by bare clay road banks and ditches. As such they provide a major contribution to the degradation of our streams and rivers through sedimentation. Erosion is further accelerated by the annual grading of road shoulders and ditches, thereby sustaining and aggravating stream sedimentation.

One of the most constructive public works programs we could embark upon that could provide employment for thousands of people is the stabilization of rural road shoulders and road banks. In too many places road ditches are much deeper than necessary to carry off the rainwater and they actually constitute a hazard to the unwary motorist. Ditches should be graded to the least depth required, with open flat bottoms, shaped as to be amenable to maintenance by mowing. Similarly, road banks should be planted to grasses, shrubs, trees or vines and kept vegetated. Such a program would be especially timely in 1975 as a means of spreading federal highway moneys to people who need it most.

Power and gas lines, while considered unsightly by some, can actually be beneficial to wildlife. Where such rights-of-way pass through wooded areas, the break in forest cover replaced by grasses, forbs, and shrubs provides habitat for quail, rabbits and songbirds. They can be further enhanced by planting of those grasses and shrubs that produce preferred wildlife food and cover.

Placement of water and sewer lines has at times contributed to needless environmental degradation. Such lines frequently follow stream courses to enhance gravity flow. Such routing, however, should not place the line in the stream bed where it will result in accelerated erosion. Contract specifications should place the lines sufficiently far from the stream to prevent entry of the excavated soil into the stream, and the re-covered lines should be seeded promptly.

**Waterways and Reservoirs**

Wherever possible, waterways, floodplains and valley walls should be designated as conservation lands. As such, they should be reserved for production of timber, wildlife and water. Recent studies also indicate that land disposal of waste water above the floodplain can substantially reduce treatment costs and return valuable nutrients to the soil, there to enhance production of agricultural or forest crops.

Many streams and rivers are severely limited in their recreational usefulness because they are clogged by stems of wind-thrown trees. This, in many places, is further exacerbated by the felling of trees into streams in the course of logging. More attention is needed at local levels to rectify this situation. Streams unimpeded by fallen trees tend to be self-cleaning and more effectively drain farm land, thereby reducing the demand for channelizing. In addition to providing fishing, many streams and rivers, if cleared of impediments, can provide canoe trails. As such they constitute a virtually untapped recreational resource. Land use planners should capitalize on this potential.

Construction of highways constitutes an ever-present threat to streams and rivers. Recently developed attention to environmental preservation appears to have ameliorated this threat. Prompt seeding of cuts and fills reduces erosion and stream siltation. Erection of silt barriers prior to and during construction is also becoming an accepted practice. Where stream channel alteration is necessary, the new channel can be dug before the water is routed into it, and it can be so designed as to provide appropriate fish habitat in the form of pools, riffles and shade.

The continuing expansion of reservoir construction on our major streams constitutes a major threat to riverine fish and wildlife as

well as removing from production thousands of acres of valuable timber resources. Whereas at one time, most of our fishing was in free-flowing streams, the balance has now tipped so far that the bulk of fishing in North Carolina is done on various types of impoundments, and many of them are considered to be underfished. Providing additional fishing opportunity can no longer be cited as a justification for new reservoir construction. Where reservoirs are the only recourse to water supply, power, or other essential human needs, they should be so designed and operated as to maintain downstream flows adequate in quality and quantity to sustain riverine wildlife species. Also, land acquisition for such projects should include waterfowl subimpoundment sites upstream as well as publically managed wildlife habitat both upstream and downstream.

# WILDLIFE AND LAND USE PLANNING WITH PARTICULAR REFERENCE TO COASTAL COUNTIES

## I. WHY CONSIDER WILDLIFE?

There is a measure of irony in the observation that whereas only a few score years ago man depended in large measure upon wild creatures for food and clothing, the potential destruction of mankind in the years ahead is heralded by his destruction of his fellow creatures through pollution of their mutual environment. This irony is further augmented by the realization that this destruction is advancing as a result of man's seeking the "better life" through technology. Nevertheless, it is becoming increasingly clear that the survival of man is inextricably tied to the survival of wild animals. It is for this reason that the use of wildlife as an "environmental barometer" is today its most vital function.

Because man emerged from the Natural Order, he can continue to survive only as a part of that Order[13]. Excessive disruption of the Natural Order by man, i.e., environmental degradation, constitutes a threat to his survival. In that the environmental and physiological requirements of wild creatures are in many respects similar to those of man, dying wildlife serves as an early warning system calling our attention to the potential destruction of human environment. When wild birds and animals are killed by application of pesticides, it is a clear indication that those pesticides can kill man. When fish are unable to survive in water degraded by industrial pollution, its use for human consumption is clearly hazardous.

Environmental interest is at an all-time high and is still growing. The peaceful observation of nature has become an effective antidote to the technological revolution that has pulled us out of our pastoral environment and engulfed us, subjecting us to all sorts of "unnatural" demands and pressure. Many of us find relief in the pursuit of fish and game with rod and gun, but bird watching and other forms of wildlife observation provide recreational relief for an even larger number.

In our rapidly urbanizing society, many are already estranged from outdoor interests, earth knowledge and pioneer skills. These

elements of our culture should remain available to future generations not only because we have found them to be pleasurable, but because we believe that they contribute to the survivability of man.

Public interest in environmental preservation was initiated in the past decade by organized sportsmen--hunters and fishermen--who were becoming increasingly concerned about the impact of technology and industrialization on fish and game resources. Rachel Carson, who crystallized this concern with her "Silent Spring"[5] was an employee of the U. S. Fish and Wildlife Service, the Federal agency charged with preservation of fish and game.

Traditionally, the wildlife conservation program in most states has been supported solely by hunters and fishermen. In North Carolina, revenue from the sale of hunting and fishing licenses is the primary source of funds for wildlife conservation. These moneys are augmented by the Federal Excise Tax on certain sporting equipment. No General Fund tax moneys are allocated to this function of state government.

In addition to its therapeutic value, the recreational pursuit of fish and game generates expenditures which constitute a substantial contribution to our State's economy. A survey[9] of North Carolina hunters revealed that they spent nearly 52 million dollars on equipment, supplies, travel and licenses during the 1972-73 hunting season. Fishermen annually contribute an equal or greater amount to our State's economy. The total food value of harvested game is also substantial. If we were to assign a market value of $1.25 per pound for game birds and animals consumed as food, and a unit value of $.50 per pound for game fish, the total would come to over $20 million per year.

There are at least two other closely related reasons why we should be concerned with the conservation of wildlife. In a strictly moral sense, man has a responsibility for preservation of his fellow creatures with whom he shares this earth. They have as much right to it as we--and probably more since they were here first. If any form of life is to lose its place in the Natural Order, let it be the result of natural forces, not the work of man.

By preservation of wildlife we provide for the continuation of the ecosystems of which we are a part. By studying the various components of these systems and their modes of interrelating operations,

In addition to their scenic beauty, coastal marshes support many forms of game and nongame wildlife and provide nourishment for aquatic microorganisms that support fish and shellfish.

we can better understand our proper place in the Natural Order--thereby assuring our own continuing survival.

Study of wildlife behavior and social organization provides for understanding of primal instincts and basic animal needs that help us to understand the evolution and nature of man[4]. Through study of other animal organisms we also develop information on biological functions, new sources of food, effect of chemicals and medicines on nutrition and health, and even development of hormones and other medical supplies. Allowing the destruction of any of our fellow creatures for short-term gain forestalls our opportunities to utilize them for our mutual survival and well-being.

Too often, in the past, economic development has been accomplished at the cost of environmental degradation. But conservation of wildlife, and other natural resources, is not necessarily antithetical to economic development. Conservation and utilization of wildlife resources can complement and enhance economic development. The maintenance of a quality environment sufficient to sustain wildlife has a salutary effect on land value. Indeed, abundance of fish and wildlife and pleasant, natural surroundings are regularly featured in development and commerce-oriented advertising.

In summary, we need to consider wildlife in land use planning because 1) wildlife serves as an "environmental barometer" and constitutes an early warning system against environmental contamination hazardous to human health; 2) the observation of wildlife and its pursuit through hunting and fishing constitute a form of highly therapeutic outdoor recreation for a substantial portion of our population; 3) the recreational pursuit of fish and game generates expenditures that contribute in a substantial way to local and state economies; 4) the study of wildlife in its natural setting provides insight on man's place in the Natural Order and valuable clues to analysis of human behavior and social organization, as well as derivation of medical and industrial products of value to human welfare; and 5) we have a moral responsibility to refrain from endangering the survival of our fellow creatures with whom we share this earth.

For these reasons, it is important that conservation of wildlife be an integral part of any land use plan. To assist him in coming to

his decisions, it is important that the land use planner be informed or have access to information on how wildlife fits into the land use pattern as well as the economy of a region, what factors enhance its preservation and what factors reduce its potential. In this way he will be in a position to make those recommendations for allocation of priorities in land use that will best provide for the welfare of the residents of the area encompassed by his plan.

## II. WILDLIFE-BASED OUTDOOR RECREATION

In recent years the number of people who engage in the nonconsumptive use of wildlife has substantially outstripped those whose interest is based on pursuit and capture. Studies conducted by the Federal Bureau of Outdoor Recreation[1] found that the most popular form of outdoor recreation is motoring, with much of it through wild areas. Since this is destined to be curtailed by the fuel shortage, it is likely that hiking, camping and picnicking will take its place in the number one slot. Canoeing, bicycling and horseback riding through wild areas, highlighted by observation of wild birds and animals, is gaining more adherents each year. Many people derive added pleasure from recording their excursions on film.

A particularly attractive aspect of these nonconsumptive uses of wildlife is that since they are less rigorous than hunting and fishing, they can be enjoyed by the entire family. But the enjoyment of wildlife does not require travel to faraway places. Wild creatures abound all about us, even in urban settings, and many people derive great pleasure from watching wildlife attracted to back yard feeders and nest boxes.

Another reason that these nonconsumptive uses of wildlife are outstripping consumptive uses is that they can be enjoyed during all seasons of the year. While most camping and hiking is done in the summer months during vacation periods, the mild winters of our State provide much pleasurable opportunity for outdoor recreation during all seasons. Canoeing and camping along eastern water courses is most enjoyable during the cooler bug-free part of the year.

North Carolina is particularly blessed in opportunities still remaining for recreational observation of wildlife. We have in this State 408 species of birds[12] ranging in size from the six-foot wing spread bald eagle to the thimble-sized humming bird. Many are resident while others are seasonal transients. Their feeding, courting, nesting and rearing of young afford countless hours of fascination for thousands of Tarheels and tourists. While there are several outstanding areas such as Pea Island, Lake Mattamuskeet and Gaddy's Pond developed to accommodate bird watching enthusiasts, equally attractive locations can be developed in any county of our State. Also, nature

trails dedicated to this and other similar uses can be developed in any municipality. Sites along streams--floodways and flood plains--provide particularly suitable habitat for a wide variety of birds and other wild creatures. The natural beauty of urban areas can be considerably enhanced by tasteful use of trees, shrubs and grasses, and low-lying areas are most appropriately dedicated to parks and greenbelts. Ottawa's surrounding greenbelt, the waterfront parks of Minneapolis, the Chicago Forest Preserve, and Rock Creek Park in Washington are famous examples.

But even the consumptive uses of wildlife--fishing, hunting and trapping--have strong recreational and therapeutic overtones. This was recently demonstrated by a study of motives of British Columbia salmon anglers[3]. One of the main objectives of the survey was to analyze motivations of anglers for undertaking their current fishing trips, to test the assumption that there is more satisfaction from sport fishing than the mere catching and eating of fish. The two most frequently listed reasons for fishing were "to take it easy" and "to be outdoors." Most of the other reasons also had recreational overtones. "To eat fresh fish" accounted for only 13.1 percent of the response. The author concluded that "sport fishing represents an ideal outlet for the frustrations of modern living in that it produces multiple benefits with few social costs." The same can be said of the other forms of consumptive uses of wildlife--hunting and trapping.

Consumptive use of wildlife--through fishing, hunting and trapping--continues to increase but at a lesser rate than the nonconsumptive uses listed above. During 1973, a total of 432,819 residents and nonresidents bought licenses to hunt in North Carolina. This compares with 401,114 ten years earlier. In that the law allows landowners to hunt on their own land without a license and in that those under 16 years of age are not required to buy a license if hunting with a licensed parent, it is likely that a total of about a half million hunters were afield during the 1972-73 season. This means that one out of every eleven North Carolinians hunted and that on the average, one family in three housed a hunter. Thus, it is evident that a very substantial proportion of North Carolinians are hunting-oriented.

TABLE I.

**HUNTING, FISHING AND TRAPPING LICENSE SALES**

| Kind of License | 1953 | 1963 | 1973 |
|---|---|---|---|
| Hunting Licenses* | 341,262 | 401,114 | 432,819 |
| Fishing Licenses* | 342,621 | 362,140 | 527,642 |
| Trapping Licenses | 2,928 | 2,992 | 3,495 |

*Includes "combination" hunting and fishing licenses.

Long-term trends indicate that the number of hunters has been increasing in North Carolina at a rate of a little over one percent per year. Provided that the opportunity to hunt is preserved, we can expect this trend to continue. Surveys conducted by the Wildlife Commission indicate that while a few species of game are in short supply, most could sustain more hunting pressure than they are presently receiving. This is particularly true of small game species--rabbit, squirrel and quail which sustain about 75% of the hunting effort. The more sedentary forms of hunting--deer, dove and waterfowl--have experienced substantial increases in recent years while forms requiring much physical effort have shown some decline. Thus, we have the potential for further increasing the opportunities for outdoor recreation through hunting in the years ahead.

North Carolina is uniquely blessed with a wide range of fishing opportunity--from deep sea fishing for marlin, to surf casting for channel bass, to estuarine fishing for speckled trout, river fishing for rock, lake and reservoir fishing for bass and crappie, pond fishing for bass and bluegill, upland river fishing for smallmouth, and mountain stream fishing for trout. Good fishing can be found in any month of the year in most parts of our State. There are opportunities for those who like to walk, fishing Mountain and Piedmont streams; those who like to sit on the bank fishing in ponds, reservoirs and estuaries; those who prefer to brave the surf; those those who like to float in a canoe or jon boat on our larger streams and rivers and those who like to cruise in charter boats off the coast.

About one out of every eleven Tarheels participates in hunting. Waterfowl hunting is particularly vulnerable to elimination through drainage of swamps.

About one out of every eleven Tarheels participates in hunting. Here too we have a wide range of opportunity: big game including deer, bear, boar and wild turkey; small game including quail, grouse, squirrel and rabbit; migratory species such as ducks, geese, doves, shorebirds (rails) and woodcock; and other forms such as raccoon, fox, wildcat, crow and groundhog. While hunting is largely seasonal, to coincide with the period of greatest abundance of each species, major forms of hunting opportunity occur from September through February. For those who like to be afield with gun during other seasons, there is crow and groundhog hunting, and in many counties the best fox hunting is during warm summer evenings.

Field trialing, particularly with bird dogs, has also developed an increasing body of enthusiasts in recent years. A primary function of these contests is to improve the quality of hunting dogs through selective breeding of champion performers. No game is taken. Similar sports center about training beagles, coon dogs and fox hounds as well as various retrieving breeds. Through much of the year, owners and trainers hold local and regional trials that culminate in state and national championships. North Carolina is in the forefront of field trialing activity and has hosted several national championship trials.

Fur trapping, once a major segment of our economy, and the lure that served as the impetus for early exploration of the new continent, still attracts a substantial number of hardy individuals in North Carolina. Muskrat is the primary objective but many other valuable pelts are taken such as mink, otter, raccoon, beaver, and wildcat. While most of our fur catch is taken by "professional" trappers, many school boys have their first taste of nature in the wild while tending an early morning trapline. Like hunting, fur trapping is scheduled for the cold season of the year to coincide with period of greatest abundance and the time when pelts are "prime." Box-trapping of rabbits is allowed the year-round for the special benefit of youngsters who enjoy this sport.

In addition to the commercial aspects of trapping, there is a growing industry based on the recreational pursuit of wildlife. In 1974 there were some 42 controlled shooting preserves in North Carolina offering hunting for pen-reared quail and other game birds.

These provided many thousands of man-days of outdoor recreation for those who for one reason or another were unable to participate in the pursuit of wild stock. Others earn supplementary income through guiding services for waterfowl and big game hunting. Still another form of commercialization has recently emerged centered about fishing in specially stocked ponds and streams. In all of these activities, however, it is only the **pursuit** that has been commercialized rather than the food value of the quarry. The people of North Carolina, through their Wildlife Commission, have traditionally strongly opposed the commercial sale of wild game.

In recent years the increasing urbanization of our society has developed a body of antipathy toward hunting and trapping, usually based on "humanitarian" distaste for cruelty. This sentiment overlooks the fact that in the Natural Order most wild animals die a violent death by the fangs of some wild predator and that this is the way it was meant to be. Civilization, however, has largely displaced major native predators and their role has to a large extent been replaced by human activity. Many species, particularly smaller forms, have a natural annual population turnover of some 85 percent due to exigencies of weather, reduced late winter food supply, natural predation, parasitism and disease. These would be reduced to a remnant spring breeding population even if there were no harvest by humans. State and federal regulations control the human predator impact so as to sustain wildlife breeding populations and most forms of game birds and animals are actually more abundant today than in earlier times.

Another item often overlooked by those opposed to hunting and trapping is that, as mentioned above, licensed hunters and fishermen pay the major share of the wildlife conservation bill. If it were not for their support there would probably not be any wildlife conservation agency and all wildlife, both game and nongame, would be threatened with extinction.

**Other Forms of Wildlife--Related Outdoor Recreation**

Survey data on other forms of wildlife and related outdoor recreation specifically for North Carolina are not available but the 1970 National Survey of Hunting and Fishing contains national figures that

TABLE II.

**NUMBER OF PERSONS NINE YEARS AND OVER PARTICIPATING IN SELECTED OUTDOOR RECREATION ACTIVITIES IN 1970[2]**

| Outdoor Recreation Activity | Percent of Population Nine and Over That Participated | Total Number of Recreation Days* |
|---|---|---|
| Picnicking | 48.9 | 10,843,220 |
| Walking for Pleasure | 29.9 | 37,210,800 |
| Boating, Sailing, Canoeing | 24.5 | 8,430,600 |
| Bicycling | 22.1 | 34,718,320 |
| Camping | 21.0 | 6,743,240 |
| Nature Walking | 18.2 | 7,487,880 |
| Horseback Riding | 9.6 | 4,176,620 |
| Bird Watching | 4.4 | 8,650,300 |
| Wildlife Photography | 2.9 | 800,960 |
| | | 119,061,940 |

*Computed as 1/50 of National Total.

may provide some insight. On the assumption that due to the abundance of natural resources the opportunity for such recreation is at least equal to that in other states, and if we can assume that North Carolinians participate at the same rate as people in other states, the figures in Table II. have some validity.

While the primary objective of those who participate in the above tabulated forms of recreation may not have been the observation of wildlife, most of it is most rewardingly accomplished in natural settings that constitute wildlife habitat. Also each of them could be considered to be enhanced by the opportunity to observe wildlife. It is particularly significant that the total number of recreation days listed is nearly 20 times the number of hunter trips per year and about four times the total annual number of fisherman trips.

## III. ECONOMIC CONTRIBUTIONS OF WILDLIFE

### Sportsman Expenditures

Expenditures by sportsmen in pursuit of fish and game constitute a significant contribution to the economy of our State. According to surveys conducted by the Wildlife Commission,[9] the "average" hunter spent $124.96 during the 1972-73 hunting season. His purchases included such diverse items as guns, ammunition, knives, clothing, boots, calls, decoys, tents and campers, dogs, dog food, veterinary service, shots and medicines related to dog care, dog training fees and kennel construction. The computed total for these various expenditures came to $51,813,000.

While we have not conducted any surveys of expenditures by fishermen, it is generally agreed that their total contribution to our economy is substantially greater because they greatly outnumber those who hunt. Among the items bought by fishermen may be listed rods, reels, lines, lures, nets, baits, clothing, boots, and boats--some very highly specialized such as the recently developed bass boats. Travel, meals, lodging and related expenses would probably add another $100 million to the total hunting and fishing bill.

Trappers spend less than either hunters or fishermen since the art of trapping has not developed the range of sophistication experienced by the other two. They do, however, spend considerable amounts each year for traps, lures, baits, stretchers, knives and special clothing.

Even bird watchers contribute to our economy through their purchase of binoculars, cameras, notebooks, feeders, feed, birdbaths, and birdhouses.

Each of these groups, in addition, spends several million dollars each year for transportation, food and lodging related to pursuit of their particular hobbies. Their expenditures help support sporting goods stores, service stations, auto sales, motels and restaurants. Several hundred commercial guides, mostly in the eastern part of the State, secure a significant part of their income from hunters who come from other sections of the State and from other states.

Other business enterprises based on hunting and fishing include preserves which offer shooting of pen-raised game birds. In some

sections, tourists are attracted to trout and catfish ponds that are stocked with commercially reared stock. Also, fishing piers have been constructed on some inland waters for the benefit of paying guests. Industrial and commercial organizations have found that providing prime hunting or fishing for company guests constitutes a highly effective business lubricant.

A survey of families in 14 southeastern states published in 1974[10] concluded that "Total out-of-pocket expenses for wildlife-oriented activities by participants for the same year amounted to $4.1 billion." This computes to nearly $300,000,000 per state. Another survey, nationwide in scope, of hunter and fishermen expenditures during 1970 came to $7 billion, or an average of $140 million per state. While there are disparities in these figures, presumably because of the nature of the surveys and details of information elicited, it is obvious that sportsmen do contribute in a very substantial way to the economy of our State and nation in the pursuit of wildlife. Preservation of these forms of recreation is well justified on economic grounds.

**Food Value**

Another aspect of the economic value of wildlife may be derived from examination of the dollar value of game and fish as food. The approximately 50,000 deer taken annually in North Carolina constitute the major food resource derived from game animals. At 75 pounds per carcass, this comes to 3,750,000 pounds of meat. A similar poundage is derived from the several million doves, quail, rabbits, squirrels; the several thousand waterfowl and raccoons; and the hundreds of turkeys, bears and boar taken each year. At an average of $1.25 per pound current market value of meat, this value approaches $10 million per year. An equal or greater value may be assigned to the food value of fresh-water fish taken by hook and line.

**Commercial Values**

Of lesser but still significant value is the commercial catch of furs and catfish and the sale of artificially propagated trout and pen-raised quail. During the 1973-74 season, the total take of raw

furs was valued at about $1.5 million. The 1974 catch of catfish by commercial fishermen in upper Piedmont reservoirs was conservatively estimated at being over $60,000.

**Monetary Value of Wildlife-Based Recreation - The Horvath and U. S. Fish and Wildlife Service Surveys**

Valuation, in monetary terms, of wildlife-based recreation has long posed a difficult question for professional wildlife managers. The need for such values is especially acute when public officials are faced with decisions in formulation of land resource projects and evaluation of multiple use of natural resources. To fulfill this need, a study was conducted from 1971 through 1973 which was based on a statistically designed sampling of families in 14 southeastern states, including North Carolina.[10] It was underwritten and sponsored by the Southeastern Game and Fish Commissioners, the U. S. Bureau of Sports Fisheries and Wildlife, the U. S. Forest Service, and the Tennessee Valley Authority. It was conducted by the Environmental Research Group of Georgia State University under the leadership of Dr. Joseph C. Horvath.

The primary purpose of the study was to determine, in monetary terms the value to the public of fishing, hunting, bird watching and other general enjoyment of wildlife. In addition to securing information on actual expenditures, it also determined the monetary value placed on wildlife-based recreation by those who indulged in these activities. This second valuation was based on 1) days of pay lost because of participation, 2) monetary value received from participants, 3) monetary value required to give up participation and 4) monetary value assigned by those who did not participate but wanted to. In this way it was possible to develop monetary values for intangible benefits (nonconsumptive values) from the enjoyment of wildlife which heretofore had been considered to be unmeasurable.

Nonharvesters of wildlife (such as bird watchers) reported higher values for their activity than did those who hunt and fish.

Based on their responses, it was determined that the monetary value they placed on wildlife enjoyment was $70.71 per day. Those who hunted valued their activity at $47.09 per day and those who fished valued their activity at an average of $42.93 per day. Big game hunting was valued at $60.86 per day, waterfowl hunting at $48.89 and small game hunting at $39.14. Saltwater fishing was valued at an average of $59.80 per day, freshwater fishing at $40.84 and trout fishing at $33.58 per day.

In response to the question of the amount of money required to give up a day of participation, it was found that a higher value was placed on forfeiture than participation. This is particularly significant in consideration of land use trade-offs that diminish wildlife resources--we tend to value most highly that which we have lost, and this, perhaps, is its truest value.

The number of days taken off work without pay to engage in wildlife-oriented activities was also analyzed. Household heads participating in wildlife-based recreation gave up an average of 4.4 work days without pay to fish, others gave up 3.9 days to hunt and those engaging in other forms of wildlife recreation gave up an average of 6.3 days of work.

Of the 16.3 million households in the Southeast, it was estimated that 4.6 million (29%) hunted during the study year, 7.7 million (42%) fished and 1.0 million (6%) participated in watching or photographing birds and other wildlife.

The survey also determined the amount of money spent annually for hunting, fishing and nonconsumptive enjoyment of wildlife. These values averaged $250 for fishermen, $162 for hunters and $197 for "bird watching." Respondents who participated in two or more of these activities reported higher annual expenditures. Total expenditures for wildlife-oriented recreation in the 14 southeastern states surveyed came to over $4 billion, or an average of nearly $300 million per state.

The survey culminated in a comparison of benefits against expenditures for wildlife-based recreation. "The total monetary benefits received by southeastern populations from the utilization of wildlife resources amounted to an estimated $24.2 billion within one year

(1971)." In contrast, "Total out-of-pocket expenses for wildlife-oriented activities by participants for the same year amounted to $4.1 billion. Thus, for every $1 they spent on wildlife recreation, participants in the southeast received $5.90 in benefits....If the estimated $50 million administrative benefits for wildlife management in the southeastern United States are compared with the $24.2 billion monetary benefits to the users, the (federal excise) tax dollar and the license dollar...yields $484 in benefits received...." The fact that each dollar spent by the Wildlife Commission produces $484 in benefits to those who in one way or another use wildlife resources is a strong argument in favor of broader public support of its efforts. This realization has, in many states, resulted in appropriations from general fund tax revenues to support wildlife programs, and is worthy of consideration in North Carolina.

Another series of surveys, conducted by the U. S. Fish and Wildlife Service, provides additional information on the economic impact generated by the recreational pursuit of fish and game. The most recent of these, conducted in 1970[2], indicated the total expenditures of all hunters came to over $2 billion and that the average hunter in this country spends $149.46 per year broken down as follows:

| | |
|---|---|
| Hunting equipment | 28.3% |
| Auxiliary equipment | 26.2% |
| Guides, dogs and other services | 21.0% |
| Food, lodging and transportation | 17.3% |
| Privilege fees | 3.6% |
| License fees | 3.6% |

It is interesting to note that of these expenditures, the smallest amounts were spent for the right to hunt--the lion's share went to support various forms of commercialization based upon the recreational pursuit of wildlife (including over 9 billion miles of automobile travel).

A further breakdown of the above figures indicated that 8% of the people in the eight south Atlantic states engage in hunting, of whom 21.4% did not buy licenses either because they were under or over the age at which licenses are required, or because they hunted on their

own land, or for other reasons. (In North Carolina disabled veterans, landowners hunting or fishing on their own land, and those over 70 years of age or under 16 years of age are not required to buy hunting or fishing licenses, and those who are blind are exempted from purchase of fishing licenses.)

Additional data on hunter expenditures by group showed that nationwide we had (in 1970) 7,774,000 big game hunters who spent a total of $952,563,000 or $122.53 per person in 54,536,000 days of hunting. A total of 11,671,000 small game hunters spent $945,634,000 or an average of $84.02 per person in 124,041,000 days of hunting. And 2,894,000 waterfowl hunters spent $244,451,000 or $84.97 per person in 25,113,000 days of hunting.

This survey showed that, nationwide, fishermen outnumbered hunters about 2½ to 1 (33,158,000 vs 14,336,000). In total, they travelled nearly 29 billion miles by car and spent nearly $5 billion, broken down as follows:

| | |
|---|---|
| Bait, guides and other | 30.8% |
| Auxiliary equipment | 30.0% |
| Food, lodging and transportation | 25.9% |
| Fishing equipment | 9.4% |
| Licenses | 2.2% |
| Privilege fees | 1.7% |

Here again, the least amounts were spent for the right to fish and the major share of expenditures went to support various forms of commerce. Nationwide, only 61.9 percent of all fishermen buy licenses and 38.1 percent fish without buying licenses. This proportion of unlicensed fishermen is also found in North Carolina.

Additional data on fishermen expenditures by group showed that nationwide we had 29,363,000 freshwater fishermen who spent a total $3,734,000 or $127.17 each. Nationwide, we had a total of 9,460,000 saltwater fishermen who spent a total of $1,224,705 or $129.46 each.

Whereas 47.5 million hunters and fishermen spent 910 million recreation days in pursuit of their sport, 6.8 million bird watchers, 4.5 million wildlife photographers and 26.9 million nature walkers spent a total of 786.3 million recreation days afield. Survey figures indicate that nonconsumptive use of wildlife is increasing more

rapidly than hunting and fishing. Whereas the two groups of users were approaching equality in 1970, we can expect the nonconsumptive users to greatly outnumber hunters and fishermen in the near future.

Other data from the 1970 National Survey of particular relevance to North Carolina was the location of residence of hunters and fishermen. The survey showed that 12.3 percent of the people in big cities fished, compared to 19.8 percent of those who lived in small cities and 25.5 percent of those who lived in towns and rural areas. Similar figures for hunters were 3.7 percent, 6.4 percent and 13.3 percent, respectively. Since most of North Carolina's population is in small cities, towns and rural areas, it is logical to assume that the proportion of our people who engage in hunting and fishing is larger than the national average.

In summary, the wildlife resources of North Carolina contribute in a very substantial way to her economy. The actual magnitude of this contribution is difficult to define. The 1972 mail survey conducted by the Wildlife Commission indicated that hunters spend, on the average, nearly $125 per year in the pursuit of their sport. More sophisticated regional and national surveys indicate that this value is probably closer to $150 when depreciation of investments in equipment, cost of hunting leases and other items are included. The National Survey found that big game hunters spend an average of $17.47 per day of hunting, waterfowl hunters spend an average of $9.73 and small game hunters spend an average of $7.62. According to the Horvath survey, southeastern fishermen spend an average of $250 per year on their sport. The national survey yielded an average annual expenditure of $127 per person and $6.30 per day. The Horvath survey found that those who indulge in bird watching and other nonconsumptive spend an average of $197 per year. Thus, it is obvious that wildlife resources have a very significant economic value.

## IV. ANNUAL HARVEST OF WILDLIFE IN NORTH CAROLINA

The magnitude of fish and game harvest is dependent upon two major factors: 1) The magnitude of the resources and 2) the amount of effort expended in its pursuit. The magnitude of the resources is limited by the amount of habitat which in turn is largely controlled by land use practices and by public concern for its survival as influenced by educational and enforcement activities.

Many changes in wildlife habitat and populations have occurred since colonial times in North Carolina. Our vast virgin forests were originally inhabited by all the species we have now and a few others such as the buffalo, elk, cougar*, wolf and passenger pigeon. The first two of these were eliminated in early times because their wide ranging habits and proclivity for grass excessively exposed them to human consumption. The second two were similarly extirpated because they conflicted with human interests and the fifth was annihilated by market hunting.

The abundance and distribution of other species were considerably different from what they are today. Bears were abundant and distributed statewide, while today they are restricted to remnant wilderness areas in our eastern swamps and western mountains. Deer were distributed statewide but the mature forests did not carry the high populations that modern cutover timber lands and farming areas support. Squirrels and turkeys were more widely distributed and abundant in the original climax forests, but quail and rabbits were relatively few as compared to today.

Our native fishes were limited to those inhabiting free-flowing waters and we did not have rainbow or brown trout. The largemouth bass so common in man-made impoundments was limited to riverine habitats and natural ponds and lakes. Anadromous fish such as the striped bass and shad were probably much more numerous.

Habitat changes and excessive exploitation reduced fish and game populations to minimum levels by the early 1900's. As a result of

*While generally considered extinct in North Carolina, previously unverified sightings were substantiated (by N.C. State University authorities) by examination of hair specimens found on the barbs of a farm fence near Charlotte in 1974.

massive conservation efforts started by Theodore Roosevelt, the tide was turned until today the total amount of fish and game, although different in composition and distribution, probably equals or exceeds that of colonial times.

A second major factor influencing the supply of fish and game is public attitude toward its conservation. With the emphasis on conservation initiated by President Roosevelt came the development of national refuges and state fish and game programs the primary elements of which were the enactment and enforcement of restrictions pertaining to the pursuit of wildlife. Hunting seasons were closed on species in short supply and when populations were restored seasons were timed to coincide with the period of greatest abundance. Season lengths were limited to remove only the harvestable annual surplus, thereby leaving adequate breeding stock not only to ensure survival but also continued increase. The development of an effective educational program by the State's Wildlife Commission augmented by a strong enforcement arm has generated strong public support for wildlife conservation.

Today, in the mid-1970's, we appear to be approaching a crossroads. Two powerful forces are pitted in the arena--in one corner the forces of conservation composed of hunters, fishermen and nature lovers have been recently reinforced by ecologists; in the other corner are the forces of unbridled development and commercialism recently augmented by vacation home builders and world food supply producers. These conflicting interests must be reconciled in the interest of preserving a living environment that will ensure survival and a quality of life for all.

As indicated above, the second factor contributing to the magnitude of fish and game harvest is the amount of effort expended in its pursuit. Among the elements controlling this effort may be listed: 1) the amount of interest in this type of activity, 2) the supply of fish and game, and 3) the amount of time available to indulge the inclination.

Surveys indicate that the amount of interest in consumptive pursuit of wildlife is continuing to increase, albeit at a slackening rate. Increasing urbanization is separating people from the land and

other forms of less rigorous recreation are replacing this interest. Data from the national surveys of hunting and fishing indicate that urbanites participate in hunting and fishing to a lesser extent than do residents of small towns and rural areas. In some states the sale of hunting and fishing licenses has peaked and the percentage of hunters and fishermen is starting to decline. In others, it is remaining stable even though the population is increasing. In North Carolina, the sale of fishing licenses from 1950 to 1970 increased at a rate greater than the rate of population increase[8] while hunting licenses sales have shown some strong fluctuations. There has been a noticeable shift in hunting interest in recent years from those forms requiring strong physical exertion toward those requiring less arduous effort. Dove, deer and duck hunting are gaining more adherents while quail, grouse and rabbit hunting, which require much walking, appear to be drawing fewer participants. This trend is further demonstrated by the increasing number of controlled shooting preserves which provide for more shooting with less walking than is required in the pursuit of wild birds. However, trout fishing, which requires much walking, appears to be increasing, along with all other forms of fishing. There also appears to be substantial increase in field trialing of various types--with quail dogs and fox, coon and rabbit dogs.

While some species such as the sturgeon, American shad, black bear and wild turkey have declined drastically from early days, the total supply of fish and game is at an all-time high in North Carolina. There is reason to hope that the turkey will recover, but we shall be fortunate to hold onto the black bear if destruction of its habitat continues at the rate experienced during the last two decades. Deer are at an all-time high and are continuing to increase and spread into new range. The major resident small game species--quail, rabbits and squirrels--are slightly down from the days of patch farming a few years ago, but will probably continue at levels more than adequate to meet demand for many years. Migratory game--doves, shorebirds and waterfowl--will probably likewise continue in adequate supply. Doves benefit from large-scale farming operations and shore-birds and waterfowl will be benefitted by current efforts aimed at habitat preservation.

The third major factor controlling the amount of effort expended is the amount of time available away from work. This apparently is increasing for most segments of society with shortening of the work-week and longer vacation times. Many workers schedule their vacations to coincide with the hunting or fishing seasons and some hunting seasons are set to coincide with legal holidays. Economic depressions and industrial layoffs increase rather than decrease the amount of time afield and increasing food costs appear to have a similar impact on hunting and fishing.

With this background on factors influencing the magnitude of wildlife harvest, we are prepared to examine the records of such harvest in North Carolina.

**Harvest of Game Birds and Animals**

The Wildlife Commission has conducted mail surveys of licensed hunters at two or three year intervals since 1951 as part of its continuing surveillance of wildlife resources. In this survey a questionnaire is mailed to a randomly selected five to ten percent of all licensed hunters and usable returns are usually received from about two-thirds of them. These are subjected to computer analysis to determine total kills of each of the game species listed in the questionnaire. Since physical limitations of paper size and mailing costs preclude listing all 14 species of game animals each year, some of the less popular species are omitted in some years, and others omitted in other years. Continuous data are thus available only for the major species of big game, small game and waterfowl.

A problem common to all surveys of this type is known as "memory bias." Because the survey must be conducted after the close of the season, and since few hunters keep records of their kills, it is obvious that precise figures are not available. Examination of returns indicates that species characterized by small bag limits--big game--are more likely to yield correct kill figures than those with large limits, such as small game. Since it is not likely that hunters will report kills exceeding bag limits for big game it is probable that big game kills, particularly deer, are slightly underestimated. On the other hand there is reason to believe that small game kills may

TABLE III

**NORTH CAROLINA HUNTER PREFERENCES, PARTICIPATION, HARVEST AND SUCCESS RATES**

*(Based on Licensed Hunter Responses to Mail Survey of 1972-73 Season)*

| Game Species | Declared Hunters | Participating Hunters | Hunting Trips | Harvest | Trips Per Hunter | Success Rates Kills/ Trip | Success Rates Trips/ Kill |
|---|---|---|---|---|---|---|---|
| Squirrel | 220,000 | 175,155 | 1,309,280 | 2,072,110 | 6.6 | 1.6 | |
| Rabbit | 197,400 | 178,925 | 1,227,920 | 1,461,780 | 6.9 | 1.2 | |
| Deer | 183,100 | 145,296 | 1,163,400 | 47,460 | 8.0 | | 24.5 |
| Dove | 157,900 | 141,107 | 716,516 | 3,064,510 | 5.1 | 4.3 | |
| Quail | 140,100 | 119,639 | 963,225 | 1,981,910 | 8.1 | 2.1 | |
| Ducks | 35,800 | 32,454 | 183,152 | 195,593 | 5.6 | 1.1 | |
| Raccoon | 37,900 | 30,172 | 304,430 | 168,437 | 10.1 | | 1.8 |
| Grouse | 20,000 | 14,854 | 80,917 | 30,846 | 5.1 | | 2.6 |
| Geese(1) | 15,600 | 12,417 | 79,438 | | | | |
| Fox(1) | 15,500 | 10,332 | 85,033 | | | | |
| Bear(1) | 11,800 | 8,698 | 58,080 | (2)261 | | | |
| Boar(1) | 7,300 | 5,112 | 16,679 | | | | |
| Turkey(1) | 6,800 | 3,670 | 9,952 | (2)94 | | | |
| Woodcock(1) | 6,700 | 3,672 | 22,437 | | | | |
| | | | 6,220,459 | | | | |

(1) Data on harvest of these species could not be secured in the 1972-73 season survey due to limitations related to the sample size and format of the questionnaire.

(2) These figures were derived from information provided by wildlife protectors and game biologists.

be exaggerated. Also, statewide surveys usually tend to exaggerate computed harvest of regionally restricted species such as grouse, bear and turkey. However, we believe the figures do accurately reflect year to year trends since th. biases are probably constant. Kill estimates of major species during the 1972-73 season are listed in Table III.

A relatively small number of Tarheels engage in fur trapping. For the past decade they numbered between 1,500 and 2,000. Higher pelt prices in 1972-73 and continued rise in 1973-74 increased the number of licensed trappers to 2,462 and then to 3,553. Traditionally, the bulk of the trapping effort is based on muskrat with most of them being taken in northeastern coastal marshes. Substantial numbers are also taken upstate, from swamps, streams, and farm ponds. Mink is usually the number one species in terms of total value, but in 1973-74 it was surpassed by raccoon. The number of fur bearers taken annually has been relatively stable, indicating a good balance between trapping effort and biotic potential of the species taken. During the past two years, however, a doubling of the value of raccoon pelts has resulted in about a 50 percent increase in take. Several fur bearers may also be taken by gun and those who hunt for these species frequently market the pelts even though they have a lower market value than those taken by trap. The magnitude and value of the statewide fur harvest for the 1973-74 trapping season are summarized in Table IV.

**Harvest of Game Fish**

The Wildlife Resources Commission conducted a statewide creel census for the inland fishing waters of North Carolina between April 1, 1970 and March 31, 1971 through a joint effort by the Division of Inland Fisheries and the Division of Protection.[8] During this period, 39,619 anglers were interviewed by wildlife protectors and the following conclusions drawn from analyses of the resulting data:

The total number of anglers fishing the inland waters during the census period was estimated at 752,506. The number of licensed anglers that year, on the basis of license sales, was 439,280 residents and 45,672 nonresidents. Legally unlicensed anglers made up

TABLE IV

**MAGNITUDE AND VALUE OF 1973-74 NORTH CAROLINA FUR HARVEST**

*(Based on Fur Dealer's Reports)*

| Species | Catch | Unit Value of Pelts | Total Value of Pelts |
|---|---|---|---|
| Muskrat | 135,266 | $ 2.58 | $ 348,986.28 |
| Raccoon* | 77,710 | 6.71 | 521,434.10 |
| Opossum* | 20,194 | 1.46 | 29,483.24 |
| Mink | 3,647 | 11.25 | 412,278.75 |
| Otter | 968 | 34.00 | 32,912.00 |
| Weasel | 116 | 1.00 | 116.00 |
| Skunk | 401 | 2.00 | 802.00 |
| Civet | 73 | 3.50 | 255.50 |
| Grey Fox* | 5,568 | 13.36 | 74,388.48 |
| Red Fox* | 1,210 | 25.00 | 30,250.00 |
| Wildcat* | 745 | 14.70 | 10,951.50 |
| Beaver | 606 | 16.50 | 9,999.00 |
| Nutria* | 11,693 | 6.50 | 16.004.50 |
| | | | $1,487,861.35 |

*A substantial but unknown proportion of these pelts are taken each year by hunters.

36 percent of the fishing public. They included an estimated 199,336 county residents fishing with natural baits and 68,218 minors--plus an undetermined number of property owners fishing from their own land, believed to be less than 1,000.

During the period 1960-1970, the number of licensed fishermen increased at a faster rate than did the total State population. The data indicated that the licensed resident anglers make an average of 45 fishing trips per year. Of the unlicensed fishermen, the "county residents using natural baits" averaged 32 fishing trips per year, the minors 22. The overall average for all legal resident anglers was 40 trips per year.

The average distance travelled for each fishing trip by legal resident anglers was 44 miles. The resident licensed anglers averaged 57 miles per trip, the "county residents using natural baits" unlicensed fishermen averaged 16 miles per trip, and the unlicensed minors 50 miles. Nonresident fishermen averaged 341 miles of travel to fish in North Carolina fresh waters. The average distance travelled per fisherman-trip decreased markedly with increasing numbers of fishing trips per year. Those anglers reporting one fishing trip per year averaged 165 miles of travel for that trip--those reporting 200 or more trips per year averaged 40 miles per trip.

By and large, the licensed resident fishermen preferred to catch a largemouth bass and the largemouth bass was the fish that most nonresidents preferred to catch in all parts of the State. The bluegill proved the most important fish, numerically, in the total rod-and-reel harvest from the inland waters. The bluegill contributed almost one-fourth of the total hook-and-line catch. Collectively, the sunfishes (bluegill, redbreast sunfish, crappie, and the "other panfishes") comprised over one-half of the total rod-and-reel harvest from the inland waters. The major game species (the largemouth bass, smallmouth bass, striped bass, mountain trout, and walleye) collectively contributed about ten percent of the total rod-and-reel freshwater harvest. Angler success averaged statewide approximated two fish caught for every hour of fishing effort.

TABLE V.

**PERCENT COMPOSITION OF FISH CAUGHT BY HOOK AND LINE IN INLAND WATERS OF NORTH CAROLINA[8]**

| Species | Percent of Statewide Catch |
|---|---|
| Bluegill | 22.1 |
| Crappie | 16.2 |
| White perch | 15.9 |
| "Other" panfishes | 10.5 |
| Catfish | 9.7 |
| Redbreast | 7.8 |
| Mountain trout | 4.9 |
| "Other" rough fishes | 4.1 |
| Largemouth bass | 3.6 |
| White bass | 1.2 |
| Pickerel | 1.2 |
| Striped bass | .9 |
| Shad | .7 |
| Carp | .6 |
| Smallmouth bass | .3 |
| Walleye | .3 |

## V. WILDLIFE AND ITS HABITAT

It is a basic premise of wildlife management that extent and quality of habitat is the primary determinant of wildlife populations. The major components of habitat are food, cover and water. Furthermore, all of these components must be present within the daily cruising radius of the species in question. Some species, like the cottontail rabbit, may have a cruising area of only an acre or two, others, like the bobwhite quail, range over an area of 20 to 40 acres, while the bobcat covers an area of several hundred acres and bears may range over 50 square miles. Migratory species travel thousands of miles from northern breeding grounds to winter feeding areas but restrict themselves to relatively limited territories at each terminus.

Wildlife has a wide diversity of feeding habits. Woodcock feed almost exclusively on earthworms but quail, grouse and wild turkey feed on green leaves, buds, flowers, roots, insects, seeds and nuts. Deer and rabbits are primarily browsers, feeding on leaves, twigs and grasses. Hawks, owls, the wildcat, weasel, mink and otter are exclusively carnivorous and kill other animals for food.

Most species of wildlife limit their numbers by staking out private territories within which they do not tolerate others of their kind. This has the effect of ensuring an adequate supply of food for the occupants of the territory. Other forms, like the deer, do not establish exclusive territories and as a result may develop population concentrations that exceed the food-producing capacity of their habitat. Some forms of fish and waterfowl travel in schools or flocks but the group usually has a well-defined cruising area.

The wide diversity of habitat requirements of different species of wildlife allows for considerable overlap in habitat use, so that a given unit of habitat can be occupied harmoniously by many different species. Thus, a five thousand-acre unit of bear range could be occupied simultaneously by a pair of adult bears and two or three juveniles, three or four families of bobcats, two or three flocks of turkeys, 100 to 200 deer, 50 or more raccoons, several dozen rabbits and squirrels, hundreds of pairs of different species of songbirds and

thousands of microtine rodents. While there can be competition for food among the various species, there is seldom competition for cover and the various species live together in relative harmony. In those cases where some species feed on others, the reproductive rate of the prey is more than adequate to assure its survival.

The quality of the habitat is largely determined by the nature and distribution of vegetation and this in turn is controlled by land use practices. Thus, the primary influence of people on wildlife is not through hunting, trapping and fishing but through modification of vegetation through land use. Many forms of land use improve the habitat for particular species of wildlife--clearcutting small patches of timber and planting corn, soybeans, or peanuts improve food conditions for deer. Quail prefer edges between grain fields and forest cover and rabbits find ideal food and cover conditions in pastures planted to pine trees (until the grass is shaded out). Other forms of land use largely preempt use by game birds and animals--the centers of large acreages of single-species vegetation are usually barren of game, whether it be a large pasture, a large soybean field or a large pine forest.

With this brief introduction on the elements of wildlife habitat, we shall now list the primary habitat requirements of the major forms of game and fish species in North Carolina.

**Game Birds and Animals and Furbearers**

The **bear** is a wilderness species, not so much because he cannot tolerate man, but more because he is considered a hazard by man and therefore can persist mainly in those places that are most remote from human habitation. In these areas he subsists on wild fruits and nuts, with occasional forays into corn fields after the ears have formed. Trees as the oaks and black gum provide a major portion of his food supply. Gallberry, huckleberry, pokeberry, blackberry and other fruit are taken in season. Grubs and bees are favored delicacies as is honey, whether found in a hollow tree or in an unprotected apiary. The bear is a solitary species except that the young travel with the mother until the second summer after they are born when she again seeks the company of a male for a brief courtship period. While a

few bears may temporarily concentrate in a particularly good feeding area, it is generally agreed that each animal requires about a thousand acres of natural range. This, coupled with their low breeding potential (about 16 percent population increment per year) means that about 50,000 acres of range relatively free of human habitation or use are required to sustain a huntable population of this species.

Land use practices favoring the black bear include: leaving hardwood swamps (particularly black gum) uncut and allowing hardwood sites to remain in hardwood production after cutting rather than converting to pine. Perhaps most important, however, is leaving extensive wild areas in a relatively undisturbed, inaccessible condition by refraining from using them as routes for new highways. Bee stands placed in wilderness areas should be mounted on pole platforms or otherwise protected from resident bears. Bears should not be blamed for being tempted by such a delicacy. After all, they were there first.

The **deer** is often thought of as a wilderness species, but it can live in close harmony with man. People have less fear of the deer than they do of bears and are much more tolerant of them. Consequently, deer are more abundant in farming areas that are interspersed with woodland than in remote wilderness areas. Deer subsist on browse (twigs and leaves of shrubs and small trees) as well as grasses and grains. Oak mast (acorns) are a highly preferred fall and winter food. Normal cruising radius of females and young can be as little as 50 acres, but bucks have been known to travel several miles during the breeding season. All parts of North Carolina other than urbanized areas can be considered good deer range. There are about a half million deer in North Carolina with largest populations in eastern counties. Other deer population centers are located in the Butner section of Granville, Person and Durham counties, the Uwharrie section of Montgomery and surrounding counties and several points scattered through the mountain counties. Herds are continuing to spread into unoccupied sections and it is possible that there will be another doubling of the population ten to 15 years hence.

Land use practices favoring deer include clearcutting in small patches and refraining from creation of large blocks (several hundred

acres) of uniformly aged pine timber. Prescribed burning as a forest management practice improves deer range by providing succulent browse. Farm production of corn, soybeans, small grains and pasture favors deer, particularly when adjacent to forest cover.

The **wild turkey**, statewide in distribution in early days, has been reduced to remnant populations in the eastern, central and western parts of the State. A vigorous restoration program based on trapping and transplanting wild birds looks promising but appears most effective in more remote localities. Turkeys are highly prized trophies and, while extremely wild and wary, are nevertheless vulnerable to the unscrupulous hunter. The species has a varied diet, primarily vegetative--seeds, fruits, nuts, berries, grasses, weeds, grains, and buds--but it also consumes insects. Grasshoppers are an important part of the diet of young birds and for this reason open fields constitute an important element of its habitat. Turkeys range over wide areas of woodland and during the spring breeding season toms seek hens over a radius of several miles. Most parts of the State have suitable habitat but because of the human harassment factor, large wilderness areas provide the best opportunities for restoration.

Land use practices favoring turkeys include retention of mature hardwoods as a source of mast and maintenance of pastures in remote areas. Perhaps even more important is preservation of wilderness by keeping roads out of such areas.

The **ruffed grouse** occurs only in our mountain counties, usually above an elevation of 1,500-2,000 feet. It is a forest species, preferring abandoned home places and second growth timber that has an abundance of wild fruits and dense cover. It also favors moist stream beds that have succulent vegetation through most of the year. While it can subsist on birch and beech buds through the winter, it has a taste for wild grapes and other fruits such as greenbrier, raspberry, partridge berry, apple, hawthorne and acorns. Dense patches of pine make good escape cover but provide little food. Hardwoods are preferred. The bird has a rather limited home range of up to about 40-50 acres. Its abundance frequently fluctuates widely since young birds are very susceptible to extremes of wet and cold in early summer. They are subject to predation by foxes, hawks and owls, but

this is generally not considered to jeopardize the population. There are no major threats to this bird's survival in North Carolina at this time.

Land use practices favoring grouse include restricting clearcuts to 50 acres or less, keeping logging roads out of stream beds, and preserving grape thickets, patches of hawthorne and abandoned home sites.

The **bobwhite quail** is North Carolina's number one native game bird in terms of hunter enthusiasts and harvest. The species is statewide in distribution with highest populations inland from the coast and lesser densities westward through the Piedmont and Mountain counties. In optimum range they may approach fall populations of two birds per acre, but there are few places in the State where this is attained. One bird per acre in eastern counties provides excellent hunting. In the Piedmont, it is about one bird per five to ten acres and in the Mountains, it is largely restricted to farming areas. Bobwhite pair during the nesting season and both parents share responsibility for brooding and rearing the young within a well-defined territory. In the late summer, the family bevies break up and a regrouping results in covey formation, each of which stakes out a well-defined covey range that may be 20 to 40 acres in extent. Both bevy and covey ranges must include all of the food, cover and water requirements needed for survival. Brushy field borders provide good nesting cover close to food, and wooded areas provide good escape cover. Thus, the bird is often called an "edge" species, since it is most frequently found at the edge between crop and timber lands.

Quail are primarily seed eaters but the young require a diet rich in proteins provided by insects. During fall, winter and early spring, they subsist on crop residues of corn, soybeans, peanuts, etc., fruits such as honeysuckle, seeds of weeds and wild legumes as well as trees such as sweet gum, poplar and pine.

Land use practices favoring quail include leaving strips of unharvested grain along field borders, allowing ditch banks to remain in weed and brush cover by burning alternate banks at two or three year intervals, leaving brushy borders along field edges and prescribed burning in pine stands.

The **cottontail rabbit** is our most widespread species of this group. **Swamp rabbits** (bluetails) are more common in eastern wetlands and also occur in wet areas well into the Piedmont. While both forms prefer woody cover, the cottontail prefers edges bordering cropland while the bluetail prefers to stay in wet areas. Rabbits are vegetarians, eating succulent weeds and grasses but relying on stems of greenbrier and other low woody vegetation in winter months. Rabbits sometimes develop a taste for planted tree seedlings, especially if they come from well fertilized nurseries. Of all the game animals, rabbits have the smallest home range, sometimes spending their entire life span on less than an acre.

Land use practices favoring cottontails include leaving brushy fence rows and shrubby woods borders for nesting cover. The dense vegetation following clearcutting of timber provides ideal rabbit habitat as does planting of pine trees on abandoned farm land. Pastures with a high component of clover provide preferred food.

The **gray squirrel** is common throughout the State and is one of the "big three" native small game species. The slightly larger **fox squirrel** is usually found associated with long leaf pine in the Sandhills and eastern counties while the much smaller **red squirrel** or boomer is restricted to higher mountain elevations. The gray squirrel's preferred habitat is the hardwood forest since it relies heavily on acorns and other nuts for food. Also taken are fruits of other species such as grape, apple, dogwood, and poplar. Mushrooms are also highly favored.

The hollows frequently found in defective hardwood trees provide escape and winter nesting cover but summer homes are usually leaf nests in hardwood trees. Most young are born in February and July and are ready to leave the nest in about ten weeks. Squirrel populations fluctuate widely and appear to be controlled by the magnitude of the mast crop. While they appear to be rather strongly territorial during the nesting season, they will accumulate in areas of abundant mast in fall and winter months. They sometimes make mass migrations for reasons not clearly determined.

The gray squirrel's heavy reliance on fruit of hardwood trees means that forest practices favoring production of sawlog hardwoods produce the most squirrels. Retention of hardwoods on hardwood sites,

particularly in the eastern part of the State, favors production of abundant squirrel populations. Leaving strips of corn along woodland borders is also beneficial, as is retaining one or two hollow den trees per acre when performing timber stand improvement.

The **raccoon** is also statewide in distribution, with much higher population levels in the eastern part of the State. This species too is strongly tied to hardwood forests and it uses hollow trees as favored denning sites. The 'coon is a rather omnivorous feeder, relying on fruits in season but also taking frogs, salamanders and crayfish from streams and larger insects such as beetles wherever they are found. Late summer corn is also a favored food. Females bear three or four young in early spring. Population densities vary considerably, from about 5 to 30 acres per animal in eastern swamps to several hundred acres per animal in mountain habitat.

Hardwood forests and corn farming favor raccoons as well as clear streams and retention of hardwood swamps. Conversely, swamp drainage, conversion of hardwoods to pine, and removal of den trees reduce raccoon populations.

The **opossum** is the poor relative of the raccoon in terms of hunter preference. They are distributed statewide but are most common in the central and eastern parts of the State. They, too, are somewhat omnivorous and feed on fruits, seeds, and insects, carrion, mice, small birds and birds' eggs. While they make some use of hollow logs and ground cavities for denning sites, they are not as strongly tied to dens since the young are carried in the female's pouch until they are able to climb to her back. Due to its sluggish movement the opossum is easy prey for most predators as well as stray or free-ranging dogs and populations are usually fairly low in spite of its strong breeding potential.

Due to its carrion consumption proclivity, the opossum is probably more closely tied to human habitation than most other game animals. It is frequently found not only in close proximity to rural residences but also in the outskirts of towns and cities. Hence, garbage dumps and sanitary land fills probably constitute a favoring factor.

Both **red** and **gray foxes** are fairly abundant in North Carolina. While neither species cleaves exclusively to field or forest, the gray

is generally considered more of a forest species. Both species have benefitted from human invasion of their original habitat, the red perhaps more so because it does more feeding in cleared areas. Foxes are highly effective mousers and exert a strong influence in keeping rodent agricultural depredations under control. They also feed on succulent fruits in season and consume some of the larger insects. Rabbits and other animals are taken when available but, as is the case with most such predation, it serves a salutary function in removing the sickly and less wary individuals, thereby maintaining the wild vigor we prefer in game animals. Poultry depredations still occur but modern mass production of poultry is not as conducive to this type of feeding as was the barnyard production of poultry in former years. Foxes are strongly territorial in nature, and population densities are rather low with several hundred acres being required to feed a pair and their young. Dens are dug in the ground and old sawdust piles provide favored denning sites. Young are born in the spring. Both the male and the female bring their catch to the den for feeding and training the young.

Agricultural practices that favor production of mice, such as hay and small grain farming, favor foxes as do forestry practices that favor production of rabbits.

The **groundhog** is largely restricted to the western part of the State with largest numbers in the high pasturelands of the northwestern counties. In recent years they have been observed as far eastward as Halifax and Northampton counties. Groundhogs are denning animals with a strong preference for pastures. Their dens present somewhat of a hazard to farm stock, and farmers usually do not object to summer varmint hunters "scoping" their fields. Groundhogs subsist largely on grasses and weeds during the summer months and hibernate during the winter.

As indicated above, the land use practice most favorable to groundhogs is pasture.

**Wildcats** shun human habitation, possibly because of canine harassment, and tend to be wilderness-oriented. While they occur most commonly in the extensive forested regions of the eastern and western parts of the State, they may be found in the larger blocks

of timberland throughout the Piedmont. They are almost exclusively predatory in nature, feeding largely on mice and rabbits, and on occasion have been known to kill small deer. They also feed on unretrieved hunter-killed deer. Like the fox, they will take barnyard poultry if available and have been known to raid turkey farms located within their home range, which is usually several hundred acres in extent. Young are born in the spring, usually two to four per litter. They are fed and cared for by the mother until they are large enough to hunt on their own. Being predatory in nature, those land use practices that result in production of prey species--mice, rabbits, squirrels, turkeys, etc., favor the wildcat.

**Muskrats** are found in largest concentrations in our northeastern estuarine marshes but are absent from marshes along our southeastern coast. They are also found inland along rivers and streams even in our mountain counties as well as in farm ponds in all parts of the State. Coastal marsh populations occur in densities up to four per acre, but these are limited to ideal habitat containing three-square, and subject to modest wind tides. While muskrats are largely vegetarian, subsisting primarily on plants that grow in or near the water, they have been known to eat snails, mussels, crayfish and salamanders. In coastal areas dens are built of marsh grass in which the young are born, usually two or three per litter. Inland, along streams and in ponds, dens are usually dug in stream banks or pond dams.

Land use practices benefitting muskrats are those that help retain the pristine quality of coastal marshes and inland waters. Marsh filling destroys muskrat habitat. Safeguarding the Outer Banks so as to preclude strong lunar tides and saltwater intrusion will also help retain the muskrats on estuarine marshes. Preserving natural channels in eastern swamplands from ditching and draining will also safeguard this species.

**Beavers** are found at scattered inland locations in various parts of the State. They were reintroduced into the State in the late thirties and early forties and have been spread to various localities by nature-loving citizens. The animals usually wander away from where they were released, and in many cases the construction of beaver dams results in the flooding of roads, croplands and timber, resulting in

landowner complaints.

The North Carolina Wildlife Resources Commission classes the beaver as a wilderness species, better adapted to those sections where streams are bordered by shrubs and trees of low commercial value. Such situations are rare in this State, since most of our streams run through bottomlands that produce hardwood timber of high commercial value.

River **otters** are found in larger streams and rivers in all parts of North Carolina. They are more abundant in eastern rivers where their favored foods are more plentiful. Otters are expert underwater swimmers and feed to a large extent on fish they pursue and catch. They are also adept at opening freshwater mussels. Otters usually travel in family groups and develop well-defined travel routes along our major waterways.

Land use practices that favor otters include prevention of stream sedimentation and pollution so as to maintain fish production at high levels. They are also benefitted by retention of eastern swamplands in their natural unchannelized condition so as to maintain their fish-producing capacity.

**Mink** are only slightly less aquatic than otters. They also feed primarily on fish but will also take crayfish and other aquatic organisms. Like otters, they have well-defined travel routes but are able to utilize smaller streams. They are found in all parts of the State. Land use practices favoring otters also favor mink.

**Weasels** belong to the same family as otters and mink, but they are terrestrial in nature. They subsist largely on mice and are fairly common but never abundant in both field and forest situations where mice are plentiful. Since it is quite likely that mice will always be with us, the preservation of weasels appears assured.

Striped and spotted **skunks** are closely related forms of the weasel family. The striped skunk is more common in the colder mountain section of the State whereas the spotted skunk is more widely distributed in the lower sections. Except for some parts of the high pasture country of northwestern counties which sometimes experience upsurges in skunk numbers, neither species is especially abundant. Both species subsist largely on insects and are especially fond of

June beetle larvae which they dig out of the pasture turf. In this way they are rather beneficial to farming interests because June beetle larvae feed on plant roots. Besides eating insects, both species are known to consume eggs of ground nesting birds; but this seldom limits bird populations unless there is a scarcity of nesting cover.

Farming practices favoring skunks include pasture and hay production as well as leaving brushy fence rows and woodland borders.

**Migratory Game Birds**

In terms of numbers taken, the **mourning dove** is our most popular migratory game bird. The dove is both a resident of North Carolina and migratory to the State. The peak of breeding activity is during midsummer but some pairs start breeding as early as January and some are still breeding into early fall. Most breeding pairs produce several broods of young per year. The peak of migration through North Carolina from northern states occurs in late August and early September with the north-bound wave passing through in December and January.

Doves are perhaps more closely tied to farming operations than any other game bird. It finds ideal feeding conditions in harvested corn and soybean fields and also utilizes other crops such as milo, millet, small grains and even watermelon (seeds). It is one of the few game birds that is favored by the increasingly large size of crop fields.

Most of the **woodcock** that occur in North Carolina during the hunting season are migrants from northern breeding grounds. Casual observation indicates that there is a substantial, but unquantified, breeding population in North Carolina. Studies have not yet determined whether North Carolina breeders winter here or further south.

Woodcocks are almost exclusively earthworm feeders and are usually found in moist wooded areas near openings such as fields, croplands or roads. They particularly favor the dense cover afforded by sprout growth, briars and brush that follow a few years after timber cutting. They use the nearby openings as "singing grounds" as well as for feeding but much, if not most, of their feeding is done along the moist wooded stream beds.

At least 24 species of game **ducks** are found in North Carolina. Based on feeding habits or habitats, they are usually divided into four groups; divers, dabblers, sea ducks and fish-eaters. The following listing, by groups, includes those species which commonly occur in the State.

| **Divers** | **Dabblers** |
|---|---|
| Canvasback | Mallard |
| Redhead | Black Duck |
| Greater Scaup | Wood Duck |
| Lesser Scaup | American Widgeon |
| Ring-Necked Duck | Gadwall |
| American Goldeneye | Shoveller |
| Bufflehead | Blue-Winged Teal |
| Ruddy Duck | Green-Winged Teal |
| Old Squaw | Pintail |

| **Sea Ducks** | **Fish-Eaters** |
|---|---|
| Surf Scoter | Hooded Merganser |
| White-Winged Scoter | Red-Breasted Merganser |
| American Scoter | American Merganser |

The major concentrations of ducks occur in the sounds, bays, ocean, lakes, timbered wetlands, and water courses of the Coastal Plains Region. Notable among these concentration areas are Currituck, Pamlico and Core sounds and Lake Mattamuskeet. In addition, the Mackays Island, Pea Island, Swanquarter, Cedar Island, Pungo and Pea Dee National Waterfowl refuges and several state-managed game lands support significant numbers of wintering and migrant species. The wood duck which is the primary summer resident, breeds in every county of the State. The attraction of the coastal area for ducks is the abundant supply and variety of suitable foods produced in the marshlands, shallow coastal sounds and timbered swamps and bottomlands. The variety of highly desirable native foods, too numerous to list, include submerged aquatic species such as sago, pondweed and wild celery; emergent marsh species such as wild millet and smartweeds;

the mast from wetlands forest species such as the oaks and ashes; and a variety of mollusks and other aquatic invertebrates.

The average annual harvest of ducks, as recorded in federal waterfowl status reports, is in excess of 130,000 birds, taken by approximately 25,000 hunters. In 1972, 30.9 percent of the duck kill was comprised of wood ducks, followed by the mallard at 18.7 percent, green-winged teal at 9.2 percent and black duck at 8.9 percent.

The **Canada goose**, a trophy bird among waterfowl species, has in the past decade reached a population in excess of 100,000 at Lake Mattamuskeet. At present, the average wintering population for all of the State approximates 50,000. A large portion of the population which formerly wintered in North Carolina now stops to winter in those states immediately to the north. The largest winter populations presently occupy Currituck Sound, Lake Mattamuskeet and Pungo Lake. Abundant natural foods occur in the waters of Currituck and in the marshes which surround Mattamuskeet. All three major wintering areas are adjacent to large corn-producing areas. Geese feed extensively on the waste corn left by mechanical harvesting, and also on newly germinated wheat, which follows corn in rotation. Although considerably reduced in numbers, the North Carolina Canada goose flock still attracts large numbers of hunters, who annually harvest an estimated 10,000 birds.

The **American brant** has decreased in numbers significantly in the last decade. Surveys indicate fewer than 200 wintering birds, which are found in close association with the eelgrass shoals of Pamlico Sound in the vicinity of Hatteras and Ocracoke. Hunting for this bird has been prohibited, beginning with the 1972-73 season.

In contrast to decreasing Canada goose and American brant populations, **whistling swans** and **greater snow geese** have increased significantly in the past five years. The 1973 midwinter inventory showed 41,700 snow geese and the 1975 inventory recorded 27,000 swans. These figures represent recent peak populations. Most of the snow geese are located on Currituck Sound and on the adjacent Outer Banks from the Virginia line south to the Pea Island National Wildlife Refuge. The swans occur in greatest numbers on Currituck

Sound and Lake Mattamuskeet. Hunting is not permitted for either species.

Several members of the rail family occur in the coastal marshes. The **king rail** and the **sora** are present in moderate to high numbers in the freshwater marshes. The **clapper rail** prefers the tidal salt-marsh, where it is found in high numbers. These birds are secretive; able to run through the marsh at a rapid pace; and are reluctant, poor fliers. The primary foods of the rail are small crustaceans, with snails and fiddler crabs being high on the preferred list. Hunting pressure is generally light; however, a moderate number of hunters go afield for the clapper rail during the high tides of September and October. These high tides nearly cover the tall marsh plants and the rails when approached by boat or by wading are more readily flushed and available to the gun. Some hunting is also done on low tide, utilizing retriever-type dogs to do the locating and flushing. Although rails are present in all of the coastal marshes, most of the hunting effort is in the Beaufort-Marshalberg-Morehead City and Southport-Shallotte vicinities.

**Fishes*(7)**

"Variety Vacationland," North Carolina's famous slogan, very aptly describes the 2.5 million acres of water lying within territorial jurisdiction of the State. Of this vast area, about one-third million acres are fresh water and these serve many community interests--not the least being the annual production of a wide variety of fishes for the recreational enjoyment of all people.

No state offers a wider selection of fresh waters than are found between the mile-high slopes of Mount Mitchell and the sandy beaches of Albemarle Sound. The gamut runs from the cold, rushing trout waters of the western mountains to the warm, placid, cypress swamps of the coastal country. In between may be found the clear, cool rivers of the wide mountain valleys, the turbid waters of the Piedmont, the meandering wide streams and the great sounds of the Coastal Plain, and the dark acid waters of the southeast. Also included are

*Most of the material in this section was excerpted from the indicated reference.

Coastal streams and rivers provide prime fishing for both anadromous fishes (hickory shad in this case) and freshwater fishes.

the large power impoundments of the Mountains and the Piedmont, the smaller community and club lakes, and the uncounted thousands of farm ponds. The fish in these waters, each adapted to a rather specific environment, are equally varied. Each has its own essential part to play in providing pleasure for the many thousands of people who enjoy the relaxation to be gained only from a day of fishing.

Not all of North Carolina's fishes are highly prized game species; some merely serve as food, others are obnoxious competitors; but all play, in one way or another, an interesting and purposeful part in the State's freshwater resources. The major species are discussed in their evolutionary sequence from the primitive to the more highly specialized forms. The listed species constitute only a small fraction of over 200 different species found in North Carolina.

The **shads** belong to the same large group of primarily marine fishes as do the herrings. The representatives of this group found in fresh water closely resemble their cousins, the oceanic sea herring and the menhaden, and also show their more distant relation to the tarpon. All are bright silvery fishes commonly traveling in large schools. Most shad and herring found in fresh water actually are marine fishes which return to fresh water to spawn. All provide important forage for the larger carnivorous fishes and some are commercially valuable as food for man. The shad and herring found in the fresh waters of North Carolina are American shad, hickory shad, alewife, glut herring, gizzard shad and threadfin shad. Some of these are rather difficult to identify positively, particularly during their juvenile stages.

Originally the **American shad** was found seasonally in every suitable river emptying into the Atlantic Ocean between Florida and the Gulf of St. Lawrence. Excessive pollution, stream siltation, and the construction of impassable dams have greatly reduced the number of streams providing suitable spawning habitat--with a corresponding reduction in the size of the shad population. The American shad is now found in many of the major coastal waters of North Carolina during the early spring, particularly in the Tar, Neuse and Cape Fear rivers.

The American shad is primarily an ocean fish that enters fresh water to spawn, and the resulting progeny remain in these waters

during their first summer of life. Shad runs, locally considered the true harbingers of spring, occur during March and April in a series of waves.

The American shad is primarily a food fish. Back in the 1890's when six to eight million pounds were harvested each year, the shad was the most valuable of all North Carolina's fishes. Pollution, siltation of spawning rivers, and overexploitation have reduced the present shad population to a mere remnant of its former abundance. During recent years, the American shad has become a very popular sport fish, particularly along the Tar and Neuse rivers during April and May.

The **hickory shad** is commonly found in most coastal streams of North Carolina during the late winter and early spring.

Large numbers of hickory shad are found on the commercial market, but they bring a lower price than the American shad. Currently, the hickory shad is gaining considerable prominence as a sport fish. For several years, Pitch Kettle Creek, a tributary of the lower Neuse has provided a lively hook-and-line sport fishery for this species during their spawning migrations of late March and early April. More recently, sport fishing for hickory shad has spread to other coastal streams.

The annual runs of **alewives**, or herring as they are more commonly called, up the coastal rivers of North Carolina actually are composed of two distinct, but very closely related, species: the true alewife and the blueback or glut herring.

Both the alewife and the glut herring are extremely abundant in the coastal waters from North Carolina northward. The glut herring also is found southward to Florida, but the alewife is not. These two fishes enter the coastal estuaries of North Carolina on their annual spawning migration in enormous numbers where they are harvested commercially for "salt herring" and canned "herring roe."

The chief function of the herring appears to be an essential link in the biological food chain between the small, almost microscopic, plankton upon which they feed, and the larger carnivorous fishes that feed upon them. They are an abundant source of cheap protein for man and are extensively harvested during their spawning migration. Very recently, the herring has attained some stature as a sport fish when

TABLE VI.

**INLAND FISHERY RESOURCES**
**OCCURRENCE, FISHERMAN PREFERENCE AND CATCH RATE***
**1970-71**

| COUNTY*** | MAJOR FISH SPECIES HARVESTED BY SPORT FISHERMEN | | FISHERMAN PREFERENCE (Five Most Important Species) | | | | | | CATCH RATE (Fish Per Hour) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ALL RESIDENT LICENSED ANGLERS | | UNLICENSED COUNTY RESIDENT ANGLERS | | NONRESIDENT ANGLERS | | RESIDENT LICENSED ANGLERS | RESIDENT UNLICENSED ANGLERS | NON-RESIDENT ANGLERS |
| | SPECIES | % | SPECIES | % | SPECIES | % | SPECIES | % | | | |
| Bertie<br>Camden<br>Chowan<br>Currituck<br>Dare<br>Gates<br>Hertford<br>Hyde<br>Pasquotank<br>Perquimans<br>Tyrrell<br>Washington | White Perch<br>Bluegill<br>Other Panfishes**<br>Catfish<br>Redbreast<br>Crappie<br>Largemouth Bass<br>Striped Bass<br>Pickerel<br>All Others | 38.7<br>18.1<br>14.2<br>10.4<br>5.7<br>5.0<br>3.5<br>2.8<br>0.9<br>0.7 | Largemouth Bass<br>Bluegill<br>White Perch<br>Striped Bass<br>Crappie | 30.8<br>25.2<br>21.0<br>9.4<br>4.9 | Bluegill<br>White Perch<br>Catfish<br>Crappie<br>Other Panfishes | 33.9<br>29.6<br>12.4<br>9.2<br>8.3 | Largemouth Bass<br>Bluegill<br>Crappie<br>Striped Bass<br>Catfish | 60.1<br>23.3<br>6.2<br>5.2<br>2.1 | 3.2 | 2.9 | 2.7 |
| Beaufort<br>Carteret<br>Craven<br>New Hanover<br>Onslow<br>Pamlico<br>Pender | Redbreast<br>Bluegill<br>Other Panfishes<br>White Perch<br>Catfish<br>Other Rough Fishes<br>Shad<br>Crappie<br>Largemouth Bass<br>All Others | 28.2<br>19.7<br>15.1<br>10.1<br>9.3<br>8.4<br>3.1<br>2.0<br>1.8<br>2.7 | Largemouth Bass<br>Bluegill<br>Redbreast<br>Other Panfishes<br>White Perch | 31.3<br>25.8<br>20.2<br>5.9<br>5.5 | Redbreast<br>Bluegill<br>Other Panfishes<br>Largemouth Bass<br>White Perch | 31.2<br>25.9<br>11.5<br>8.8<br>7.9 | Largemouth Bass<br>Redbreast<br>Bluegill<br>White Perch<br>Crappie | 58.3<br>12.5<br>8.3<br>8.3<br>4.2 | 1.7 | 1.3 | 1.3 |
| Brunswick | Other Panfishes<br>Bluegill<br>Redbreast<br>Catfish<br>Pickerel<br>Crappie<br>Largemouth Bass<br>Other Rough Fishes<br>White Perch<br>All Others | 27.5<br>19.0<br>18.9<br>11.5<br>8.6<br>8.0<br>3.2<br>2.5<br>0.3<br>0.5 | Redbreast<br>Largemouth Bass<br>Bluegill<br>Other Panfishes<br>Crappie | 28.1<br>24.0<br>19.1<br>9.2<br>8.8 | Bluegill<br>Redbreast<br>Other Panfishes<br>Catfish<br>Largemouth Bass | 33.5<br>28.5<br>14.5<br>8.0<br>7.5 | Largemouth Bass<br>Redbreast<br>Crappie<br>Bluegill | 36.3<br>27.3<br>18.2<br>18.2 | 1.7 | 1.8 | 0.9 |

*Data from special N. C. Wildlife Resources Commission report entitled "Sport Fishery Statistics from the Inland Fishing Waters of North Carolina, 1970-71," dated November 1974.
**Yellow perch, warmouth, flier, etc.
***Counties grouped according to N. C. Wildlife Commission Districts--as original data were analyzed according to these district areas.

Wooded swamps support wood ducks, squirrels, raccoons, and many species of songbirds. They act as detention reservoirs to prevent downstream floods and serve as underground aquifer replenishment areas. They settle, filter and transform organic wastes into innocuous inorganic compounds that contribute to the biotic growth potential. They produce micro-fauna and -flora that nourish larger organisms in downstream sections. They produce large volumes of valuable timber. They serve as spawning areas for anadromous fishes such as the herring. All told, hardwood swamps are probably the most productive sites in eastern North Carolina and every effort should be made to preserve the few that remain.

it was discovered that they will strike at a very small spinner or a streamer fly.

Three species of **trout**--the brook, rainbow, and brown--now live in North Carolina waters. Of these, only the brook is native. It once was widely distributed in most streams along the eastern slopes of the Alleghany Mountains. Logging and farming, associated with settlement of the mountain country by the white man, have altered much stream habitat by removing the protective forest shade cover and by accelerating run-off and attendant soil erosion.

The brook trout has been forced from its former haunts well back into the headwater country that is too hilly to log or to farm. The larger fast-flowing white-water streams vacated by the brook trout were, nevertheless, ideal for the rainbow trout--an exotic fish relocated from the Pacific Coast. The brown trout, an immigrant of Scottish and German ancestry, fitted ideally into the open meadow streams at lower elevations that became too warm for the brook trout and that were too slow for the rainbow. The trout water of North Carolina is being fully utilized by three species now where originally there was but one.

The three trout are sought by a devoted army of some 55,000 anglers over the 3,350 miles of streams and the 3,350 surface acres of cold-water reservoirs that comprise the trout habitat of North Carolina. Natural trout reproduction is aided by a vigorous program of artificial propagation and seasonal stocking of yearling "keeping size" trout. Currently, trout constitute about four percent of the annual freshwater sport-fish harvest in the State.

In North Carolina, the **brook trout** is restricted to headwater streams generally above an elevation of about 3,000 feet. It remains the most eagerly sought of all trout, perhaps because reputedly it is the most easily caught. It ranks among the most ornamental of all freshwater game fishes, and its flesh is often considered to be superior in texture and flavor to that of any other freshwater fish.

The native haunts of the **rainbow trout** are the large, cold rivers of the Pacific Coast. Stock from the McCloud River of California was brought east in the 1880's and since then rainbows have been extensively propagated and widely distributed to almost every stream of suitable

temperature and habitat. In North Carolina, the rainbow trout is found in seven of the western mountain reservoirs and in most of the larger streams between 2,000 and 3,000 feet in elevation, and which do not frequently exceed summer temperatures of 75°. The rainbow retains some of its migratory instincts and may be found well down into the Piedmont rivers during the winter months. Without the rainbow, trout fishing in North Carolina would be but a minor fraction of its present magnitude.

The present-day **brown trout** is the offspring of a hatchery blending of the von Behr trout, imported from Germany, and the Loch Leven trout imported from Scotland. In North Carolina it has become established in many of the larger, slow-flowing streams of the open western meadows that are transition waters between trout and smallmouth bass habitat.

The brown trout is the favorite of many skilled anglers, for they are the most difficult of all trout to catch. This trout presents a real challenge to the abilities of the fisherman for, while they strike either bait or artificial lures savagely, the lures must be skillfully presented and at the proper time. Dry-fly fishermen regard the brown with particular favor because they rise best during the quiet early evening hours. The brown trout also is regarded highly by the fish manager because it tolerates more turbid water than the other trout and, once established, is almost impossible to "fish out."

Three species of the **pickerel** family are found in North Carolina, the redfin pickerel, the chain pickerel, and the muskellunge. The muskellunge formerly inhabited the French Broad and Little Tennessee rivers of western North Carolina but has been reduced to extinction by pollution and siltation. A fourth member of the pickerel family, the northern pike, was introduced into Lake Phelps, Gum Swamp Lake, Greensboro Club Lake, and Lake Adger in 1958. There is no evidence up to the present time that any of these introductions was successful. Although very popular with anglers, the pickerels contribute less than one percent of the total freshwater sport-fish catch.

The **redfin** pickerel is found generally throughout the clear, unpolluted, usually acid streams and swamps of the Coastal Plain and as far west into the Piedmont as the Catawba River drainage. Young red-

fin feed on plankton, then on aquatic insects, and finally, at a length of about three inches, upon a diet almost exclusively of smaller fishes. It is an excellent little game fish for its size--which seldom exceeds one foot in length or one pound in weight. Albeit bony, the flesh is white, sweet, and of excellent flavor.

The **chain pickerel** is found in most unpolluted swamp-fed streams and bays of the Coastal Plain, through the black-water lakes and streams of the Piedmont, into the Yadkin River drainage. It is one of the more popular game fishes of eastern North Carolina.

The **carp** stems from an ancestry that, world wide, was highly esteemed as food fish, at least until its arrival in the United States. Originating in Asia, it was brought to Germany, and to many other European countries as well, several centuries ago. The carp was introduced into the United States about 1876. Story has it that the first release of carp into wild waters was effected by the Potomac River flooding a public display pool at the base of the then-unfinished Washington Monument. In North Carolina, the carp now is found in almost every large river and lake below an elevation of approximately 2,000 feet. It is particularly abundant in Currituck Sound and other bays of northeastern North Carolina.

Although the carp is considered a relatively low-grade food fish, it can provide very exciting sport fishing on light tackle. Carp contribute 1.6 percent to the sport-fish catch in fresh water. Sport fishing for carp is centered in the large power reservoirs of the Yadkin and Catawba rivers.

Offsetting the importance of the carp as a sport fish are the adverse consequences of its obnoxious feeding habits. Any water containing a fair population of carp usually will be turbid from the continual rooting of the bottom by carp in search of food. The shading effect of the suspended mud greatly restricts growth of plant life which is the primary basis of survival for all animals. The settling turbidity also smothers fish eggs, particularly those which are not attended by the parent fish. All told, the carp must be considered as a nuisance although not an altogether unmitigated one.

The **suckers** are another large family of fishes, particularly in North Carolina which reputedly has more species of suckers than any

other state. Two rather widely separated species of suckers are described as representatives of the entire family.

In North Carolina, the **chubsucker** is found in most rivers, lakes, and millponds of the Coastal Plain extending as far west as the lower reservoirs of the Catawba River. Young chubsuckers feed upon minute plant and animal life, gradually changing to their adult diet of aquatic insect larvae sucked up and strained from the substrate. There is ample evidence that the chubsucker is quite partial to fish eggs when these are available.

The chubsucker is netted in large numbers during their spring spawning runs as a source of food for local consumption. When taken from cold water, the flesh is firm and of good flavor, albeit bony. During midsummer, however, the flesh softens and acquires less desirable flavors. The chubsucker provides some sport fishing as it occasionally will take a small wet fly, but more frequently a worm. It serves as a valuable forage fish, particularly in many coastal waters too acid to support the usual minnows. This desirable characteristic is offset, in some measure at least, by its predilection toward a diet of fish eggs when such are available.

The **redhorse sucker** actually may be any one of some 13 species of large suckers that look so much alike that only an expert can determine to which species a given specimen belongs. Insofar as is now known, all species of redhorse suckers are essentially alike in their life histories and habits. Redhorse suckers are found throughout most waters of North Carolina with the exception of the high trout waters and the swamp streams of the southeast.

The young feed first on microscopic plants and animals, later on plankton, insect larvae, and, when available, fish eggs. The maximum recorded length of a redhorse sucker is 24 inches, but few exceed 18 inches in length. The redhorse suckers contribute their fair share to the widespread springtime netting operations which generally provide social occasions as well as food for the table. Most suckers are taken for home consumption rather than the commercial market. The larger suckers of the State are a neglected food resource. This resource should receive greater exploitation not only because of the currently

unharvested food involved but to achieve some reduction in their numbers, thereby producing better game fish habitat.

Members of the **catfish** family scarcely need description for they resemble no other freshwater fish found in North Carolina. They have a characteristic elongate, streamlined body with a flattened head bearing two long, and two short, fleshy barbels above a large mouth and four "chin" barbels below. The barbels contain sensory receptors which enable the catfish to locate food by "smell"--a useful mechanism in the murky waters often inhabited by the catfishes.

At least 12 species of catfishes are found in North Carolina waters, only four of which are of direct importance to man. One large group of the catfish family is popularly called bullheads. There is little practical difference between a catfish and a bullhead other than the smaller size of the latter and their tendency to inhabit smaller, and perhaps muddier, waters. In all North Carolina waters, other than the Little Tennessee River basin, a bullhead can be distinguished from the catfish by its square or rounded tail in contrast to the deeply forked tail of the catfish. The flathead catfish that inhabits the lower reservoirs of the Little Tennessee River is an exception to the rule in that it has a blunt tail.

The catfishes, as a group, are held in disrepute by some sports fishermen because of a fondness for eating fish eggs. There is little doubt that the catfishes live well when such fishes as herring and carp are spawning, but whether they are serious predators on the eggs of most game fish has been questioned. The catfishes are very popular with most sport fishermen, however, as revealed by a recent statewide creel census during which 26 percent of all successful fishermen contacted on other than trout streams had at least one catfish in the creel. In the overall picture, catfish comprise ten percent of all sport fishes taken from the fresh waters of North Carolina in addition to supporting a widespread and lucrative commercial fishery in the inland waters.

Originally the **channel catfish** was native to the Mississippi and Great Lakes basins. It is found generally throughout North Carolina waters with the exception of the highest trout lakes and streams.

It is most abundant in the large rivers and lakes of the Piedmont and Coastal Plain regions.

From the time of hatching, the channel catfish is omnivorous and will eat almost anything that can be devoured. The preferred items of diet appear to be insects, worms, fish (both live and dead), fish eggs, and various vegetable seeds and fruits. It grows rapidly and the females reach sexual maturity at from 13 to 16 inches, the males at a somewhat smaller size. In North Carolina, channel catfish seldom attain a weight of five pounds, most of them growing to one to two pounds.

The channel catfish is the favorite of many anglers and in some areas deserves recognition as the only available game fish. It is more of a daytime feeder than the other catfishes and is readily caught on worms, cut-bait, liver, meat scraps, dead minnows, or other more odoriferous baits. When taken from cool, clean waters, the flesh of the channel catfish is delicious.

Distribution of the **white catfish** in North Carolina is similar to that of the channel catfish, although it is seldom found west of the Catawba River watershed. Like the channel catfish, it is an omnivorous feeder. It is principally a night feeder, so more are taken on trot lines or in traps than by hook and line. The flesh is of good quality but not regarded as highly as that of the channel catfish.

The **brown bullhead** is probably the best known member of the catfish family. It is found generally throughout North Carolina excluding all mountain waters other than the French Broad. It supports an enthusiastic cane-pole fishery throughout its entire range. When taken from cool, clean water, the flesh is very tasty. The bullhead quickly acquires an off-flavor in warm, muddy, or heavily polluted water.

The **yellow bullhead** is found generally through the Coastal Plain and into the Piedmont as far west as the lower reservoirs of the Catawba River. It is the least prized of the North Carolina catfishes, although it does provide a fishery in streams too muddy or too polluted to support other edible fishes. The flavor and texture of its

flesh are only fair at best. The yellow bullhead is sought principally as meat for the home table, nevertheless it does provide some sport.

The **American eel** spawns in the Sargasso Sea in the western Atlantic between Bermuda and the West Indies. The female eel produces about 10,000,000 eggs. The eggs hatch releasing a larval stage that bears little resemblance to the adult fish. The larval eels drift northward with the Gulf Stream, developing into the adult stage as they approach the North American continent. Young eels are only two to three inches long when they leave the ocean for fresh water, but they are already two or three years old. The American eel matures at six to eight years of age when it returns to the Sargasso Sea, there to spawn and die.

The American eel is found in almost all waters that ultimately drain into the Atlantic Ocean and which are not blocked by impassable dams. In North Carolina, the latter factor precludes their presence in waters of the Little Tennessee, Savannah and Catawba watersheds. East of the Yadkin, however, the eel is very commonly found, sometimes even in land-locked ponds into which they apparently migrate overland during rains or heavy dew.

The American eel reputedly is the most voracious of all carnivorous fishes. It is almost exclusively a nocturnal feeder. It is frequently caught by angling but mostly by commercial fishermen on trot lines or in traps, usually called "eel pots." The eel will eat almost anything. Stomach analyses have revealed water plants, insects, crayfish, frogs, fish eggs, fish (including smaller eels), garbage, water birds, and even muskrats. The white flesh of the eel is highly esteemed, and it is frequently smoked or otherwise cured as a delicacy. Because of their availability, however, the eel commands a low price in the commercial market.

The **basses** belong among the spiny-rayed fishes, so-called because the dorsal and anal fins contain sharp, stiff spines, as well as soft rays. The true basses found in North Carolina's fresh waters can be identified by the double dorsal fin with the front portion, containing only spines, distinctly separated from, or at best but

slightly conjoined with, the rear portion. They also possess gill-like structures on the inner surface of the gill covers technically known as the pseudobranchiae. The largemouth bass comes close to meeting the fin specifications of the basses but, because of the absent pseudobranchiae, it is classed among the sunfishes. The only true basses found in the fresh waters of North Carolina are the striped bass, the white bass and the white perch.

The **striped bass** is found along the entire Atlantic Coast from New Brunswick to Alabama. There is little evidence, however, that the striped bass of North Carolina intermix with those of other areas. Except for the "jumbo rock" taken in the winter net fishery off the Outer Banks, the striped bass of North Carolina appear to spend their entire lives in Albemarle or Pamlico Sounds. During the annual spring spawning run, mature stripers are found in the Roanoke, Cape Fear, Neuse and Tar rivers and--perhaps less frequently--in other coastal rivers including the Pee Dee up to Blewett Falls Dam. The striped bass has become landlocked in the John H. Kerr, Gaston, and Roanoke Rapids reservoirs either through the accidental trapping of adult spawners when the dam gates were first closed, or through subsequent liberations of several million fry propagated at the Commission's striped bass hatchery at Weldon. During recent years, striped bass also have been relocated, either as fry, fingerlings or adults, into Lake Phelps, Lake Lure, Lake Hickory, Lake Rhodhiss, Lake Norman, High Rock Lake, Blewett Falls Reservoir and Lookout Shoals Reservoir. There is no evidence, as yet, that the striped bass has become established in any inland water of North Carolina other than the Roanoke River reservoirs which flooded their ancestral spawning grounds.

In the early days when fishing was less intense some striped bass lived to an advanced age, a pair reported seen at Edenton in April, 1891, each of which weighed 125 pounds. North Carolina striped bass weighing more than 20 pounds now are a rarity. The average weight of fish taken at the present probably lies between three and five pounds. The striped bass remains primarily a fish-eater throughout its entire life.

It is the largest and one of the best game fishes available in inland waters. In addition, it ranks among the more valuable com-

mercial food fishes of North Carolina. Commercially, it is taken in the sounds principally by pound nets and, in the rivers, by trot line and bow nets. As a sport fish it is widely sought with artificial lures, cut-bait, and, in the rivers, with bow nets. The striped bass now contributes about one percent of the total sport catch from North Carolina's inland waters. The Roanoke River near Weldon and the fresh waters contiguous to Albemarle Sound provide about 90 percent of the inland sport catch.

The **white bass** is a native, large-water fish of the Great Lakes and the Upper Mississippi drainages. It was introduced into the Yadkin and Catawba rivers reservoirs during the early '50's.

The white bass is a desirable exotic for not only is it an excellent game fish but, being an open-water fish, it does not compete for living space with such shore-loving natives as the black bass. The white bass travels in schools, so fishing is either excellent or nonexistent depending upon how successful the angler has been in locating a feeding school. It has been a very valuable addition to the North Carolina sport fishery and it now contributes slightly more than one percent of the total freshwater sport-fish harvest. Fishing for white bass in North Carolina today stems largely from the Yadkin and Catawba rivers introductions, consequently these waters currently provide about 95 percent of the white bass catch. Fontana Reservoir also supports a popular white bass fishery.

The **white perch** is a rather plain fish which, depending upon its habitat, may vary in general coloration from silvery to almost black. The larger specimens may show indistinct longitudinal stripes along the sides, but these never are as pronounced as those of the striped bass. The white perch is native to salt, brackish, and fresh waters of the Atlantic Coast. It is found natively throughout the coastal waters of North Carolina and as far inland as the Yadkin River watershed. The food of the young white perch is mainly aquatic insects. The adults feed principally upon insects and small fishes.

This pan-sized member of the bass family is of greater importance as a commercial fish than as a sport fish. The white perch is an excellent game fish under conditions of sufficient predation or ex-

ploitation to prevent overpopulation. The white perch is extremely prolific and it grows rather slowly. In less favorable environments, such as many of the coastal lakes and the inland reservoirs, the white perch rapidly degenerate into a stunted population of great number. Even so, it makes up about 13 percent of the freshwater sport catch, most of which is taken from Albemarle Sound and contiguous fresh waters and from High Rock and Tuckertown Reservoirs of the Yadkin River.

The **sunfishes** are native to North America and, except for a single species, originally were found only east of the Rocky Mountains. All members of the family are very ornamental fishes, some grow to a large size while others, like the Pigmy sunfish, never exceed an inch or two in length when fully grown. This very large family of spiny-rayed fishes contains the majority of our game fishes by number of species as well as by numbers of individuals. Catch statistics leave no room for doubt about the importance of the role played by the sunfishes in North Carolina's sport fishery. The black basses contribute about four percent, the two crappies 19 percent, and the "bluegill" type sunfishes--in aggregate--44 percent of the total freshwater sportfish harvest!

The **largemouth bass** is the largest and probably the most important game fish within the sunfish family. It is native to the eastern United States from the Great Lakes to Mexico. It has been widely propagated and now is found in every state and in many European and South American countries as well. Present in virtually every lake and reservoir of North Carolina and in many of the warmer rivers and streams, the largemouth is particularly abundant in Currituck Sound and other fresh waters contiguous to Albemarle Sound. It is usually missing, however, from the extremely acid waters in the southeastern part of the State. The largemouth is, of course, the predator fish usually stocked in the many farm ponds of North Carolina.

Animal plankton and small insect larvae form the principal food of the young largemouth until they have reached a length of about two inches. Thereafter, the largemouth becomes a very active predator and will eat almost any living prey that it can catch and swallow. Crayfish, large insects, frogs, and smaller fishes appear to be their favorite foods.

The largemouth bass, which is found in almost any situation where the water is pure and the food supply adequate, vies with the bluegill as the most popular inland game fish. Not only is the largemouth present in a wide variety of public waters scattered over most of North Carolina, but it also forms the foundation of a tremendous farm-pond fishery. The largemouth is a top-quality game fish in every respect and it may be taken by virtually every known method of angling. The contribution of the largemouth bass to the overall sport-fish harvest from the inland waters is slightly less than four percent.

The **smallmouth bass** originally was found over much the same range, but in much more restricted habitats, than the largemouth. Typical smallmouth waters are the large clear streams, rivers, and lakes of a temperature just slightly warmer than that preferred by trout. It is not at all unusual to find both trout and smallmouth present in the same transitional reach of river that lies between the definitely trout water above and the definitely warm-water fish habitat farther downstream. Unlike the largemouth, which will spawn in anything other than soft mud, the smallmouth is very specific in its requirement for a stream bed of clean gravel or fine rubble. In North Carolina, the smallmouth is typically a fish of the mountains and the foothills. It was native to the western streams from the New River to the Hiwassee, and it has been successfully relocated to the upper reaches of the Yadkin, the Catawba, the Broad, and to many of the western reservoirs. Occasional smallmouth have been reported from the lower reaches of some coastal rivers, notably the Northeast Cape Fear and the Meherrin rivers. The few specimens from the coastal streams that have been proffered for critical examination have more closely resembled one of the spotted basses.

Food habits of the smallmouth are quite similar to those of the largemouth. The adult smallmouth, however, shows a decided preference for crayfish and the larger insects, and the smaller fishes seem less important constituents of its diet. The smallmouth does not reach the size attained by the largemouth.

To many anglers, the smallmouth is the "gamiest" fish that swims and certainly all agree that it rates very highly as a sports fish.

It seems less susceptible to artificial lures than the largemouth--certainly fewer are so taken. The smallmouth now is generally found in suitable large streams and in most reservoirs lying above an altitude of about 1,200 feet. Although a very glamorous game fish, the smallmouth bass contributes only some 0.2 percent of the total sport-fish catch.

The original home of the **bluegill** included most of the states east of the Rockies. Because of its adaptability to a broad range of habitat, it has been widely distributed over the entire world. It is almost universally present throughout North Carolina fresh waters except for the cold, swift-flowing, trout streams. The bluegill characteristically is an inhabitant of vegetated, quiet or slowly-moving, reasonably clean waters. It is widely used in farm ponds as a harvestable forage fish.

Young bluegill feed upon plankton, switching to aquatic insect larvae as they grow larger. Insects remain the principal food of the bluegill throughout life. On occasion, the bluegill feeds readily upon fish eggs and fry, including their own. Under very crowded conditions, the bluegill may completely prevent bass reproduction by consuming their eggs.

The bluegill has been considered as an insignificant fish, fit only for juvenile anglers--until fly fishing became popular. Whether the bluegill or the largemouth is the more popular fish in North Carolina is a moot question. There is little doubt, however, that the bluegill provides a great deal of sport for an extremely large number of fishermen.

The **redear sunfish** originally was native to the Mississippi River drainage. It was widely distributed throughout eastern North Carolina during the early 1950's and now is found principally in the quieter southern waters and in the lower Yadkin River reservoirs.

The redear sunfish is considered a good game fish among those anglers who prefer to fish with natural baits. Under favorable conditions, the redear will outgrow the bluegill and, during recent years, it is being used more and more as a bluegill associate in small ponds.

The original haunts of the **redbreast** were the streams of the Atlantic and Gulf Coasts from Maine to Louisiana. It is widely dis-

tributed throughout North Carolina waters and is now found in every watershed of the State with the possible exception of the Watauga. It feeds principally upon insects, small clams, snails and small fishes. It is unquestionably the most important sunfish found in warm-water streams.

The **flier** inhabits the quiet lowland waters from Virginia to Louisiana and the Mississippi Basin as far north as southern Illinois. In North Carolina, it is found around sunken logs and stumps in the mill ponds and the back-waters of the Yadkin River drainage and eastward. The foods of the flier appear to be the typical insect, snail, clam, and occasional fish egg or fry diet of the smaller sunfishes. It is more popular with the sports fisherman than most of the smaller sunfishes, for, like the bluegill, it rises readily to small popping bugs as well as to wet and dry flies.

The **warmouth** is found in muddy lakes, ponds, and slowly moving streams from the Great Lakes to the Gulf on both sides of the Appalachian Mountains. It is generally present throughout North Carolina waters as far west as the Catawba River and occasionally in the French Broad watershed. The warmouth prefers to live among submerged snags and vegetation in relatively shallow, mud-bottom waters. It is found in sluggish streams but generally it is more common in quiet waters. It is mostly favored by the bait fisherman in quest of a readily available dinner.

The original distribution of the **rock bass** was the upper Mississippi drainage, the Great Lakes, and the northeastern states. In North Carolina, it occurs in the New River, in the Tennessee River system from the Watauga to the Hiwassee and on eastward into the upper Catawba and Yadkin River watersheds. The rock bass, like the smallmouth, is a cool-water species and attempts to establish it in the coastal rivers have not proven very successful. Its food is mostly insects, crayfish, and small fishes. The rock bass provides excellent sport that is very often encountered incidental to fishing for smallmouth bass.

The **white crappie** originally was a species of the central Mississippi Valley and the Great Lakes. It has been widely distributed over the United States and was brought into North Carolina

only a few years ago. The white crappie will tolerate somewhat warmer and more turbid waters than are preferred by the black crappie. It is generally found throughout the lakes and slower moving streams of North Carolina from Cheoah Reservoir in the extreme west, eastward across the Piedmont, but it virtually disappears within the Coastal Plain. Very few are found in the coastal waters.

The white crappie is an excellent game fish wherever sufficient food or active predation prevent overpopulation and subsequent stunting at a uselessly small size. Because it is a schooling fish, anglers often encounter exceptional fishing if they remain in the vicinity of the first bite. The greatest drawback of the crappie is its strong tendency to multiply beyond the supply of food. Crappie fishing generally is popular throughout the State but probably reaches its zenith in the large reservoirs of the Yadkin and Catawba rivers.

The **black crappie** originally was found over much the same geographic area as the white, and like the white it has been widely distributed. It prefers larger and cleaner waters than does its cousin. Although found generally throughout North Carolina waters east of the mountains, the black crappie reaches its greatest dimension as a game fish in the clear, dark-water lakes and large rivers near the coast. The breeding habits, growth pattern, and food preferences are essentially the same as those of the white crappie.

The advocates of the black crappie consider it a "gamier" fish than the white but this is debatable. Generally speaking, the black crappie does seem of greater stature as a game fish in North Carolina than the white crappie--perhaps because the latter, being an introduced species, finds no habitat to which it is as well adapted as is the black crappie to its native coastal waters. Under optimum conditions, both species are excellent game fishes and very highly regarded by the bait fisherman and the artificial lure enthusiast alike.

The term "**perch**" is rather indiscriminately applied to many freshwater fishes. There are but two perch of direct interest to fishermen found in North Carolina fresh waters: the yellow perch and the walleye.

The **yellow perch** originally was found only in the large streams and lakes of coastal North Carolina, but now it generally occurs as far west as the lower reservoirs of the Catawba River and occasionally in the lower Hiwassee and Pigeon rivers. The young slow-swimming fry travel in schools feeding upon minute animal life. Later, the yellow perch feeds principally upon insects, young fishes, and small crustaceans. Growth is comparatively slow, the yellow perch seldom exceeds one foot in length or one pound in weight, most of those caught being considerably smaller. While the yellow perch is not among North Carolina's prize game fishes, it is of excellent quality and flavor.

The **walleye** originally was a resident of the Upper Missippi Valley and south-central Canada. Because it was such a fine game fish, it was widely distributed during the 1800's from Hudson Bay to northern Georgia wherever its preferred habitat of a large, clear, deep river or lake was available. It was introduced into North Carolina over a century ago and became well established in the French Broad, Little Tennessee, and Hiwassee river systems. Back in 1860, the walleye was the favorite food fish of the French Broad and "fishing" for them often was accomplished with a rifle. Pollution and siltation have come close to exterminating this clean-water fish from the French Broad and Little Tennessee rivers. An occasional specimen still is taken from the Roanoke River, reputedly progeny of stock released many years ago from the Federal fish hatchery at Edenton. Starting in 1950, attempts again were made to relocate the walleye into virtually every impoundment of suitable size from the Yadkin River west. All attempts in the Yadkin River reservoirs proved fruitless. A walleye occasionally is taken from Catawba, Rhodhiss, Glenville, Nantahala and Appalachia reservoirs. The relocation efforts did produce a major sport fishery for walleyes in Lake James as well as in Fontana, Santeetlah and Hiwassee reservoirs.

The fry feed upon microscopic plant and animal life--a diet that soon changes to include larger organisms up to fish of almost

equivalent size. The walleye is a voracious feeder and will consume almost anything that moves. It is the favorite game fish of the deep-water fishermen as it is seldom taken on baits of any kind fished near the surface, except during very early spring and late fall. The walleye contributes about 0.2 percent to the total freshwater sport-fish catch.

## VI. RARE AND ENDANGERED SPECIES

On December 28, 1973, the United States Congress passed the Endangered Species Act of 1973 (Public Law 93-205). This act was passed pursuant to findings that:

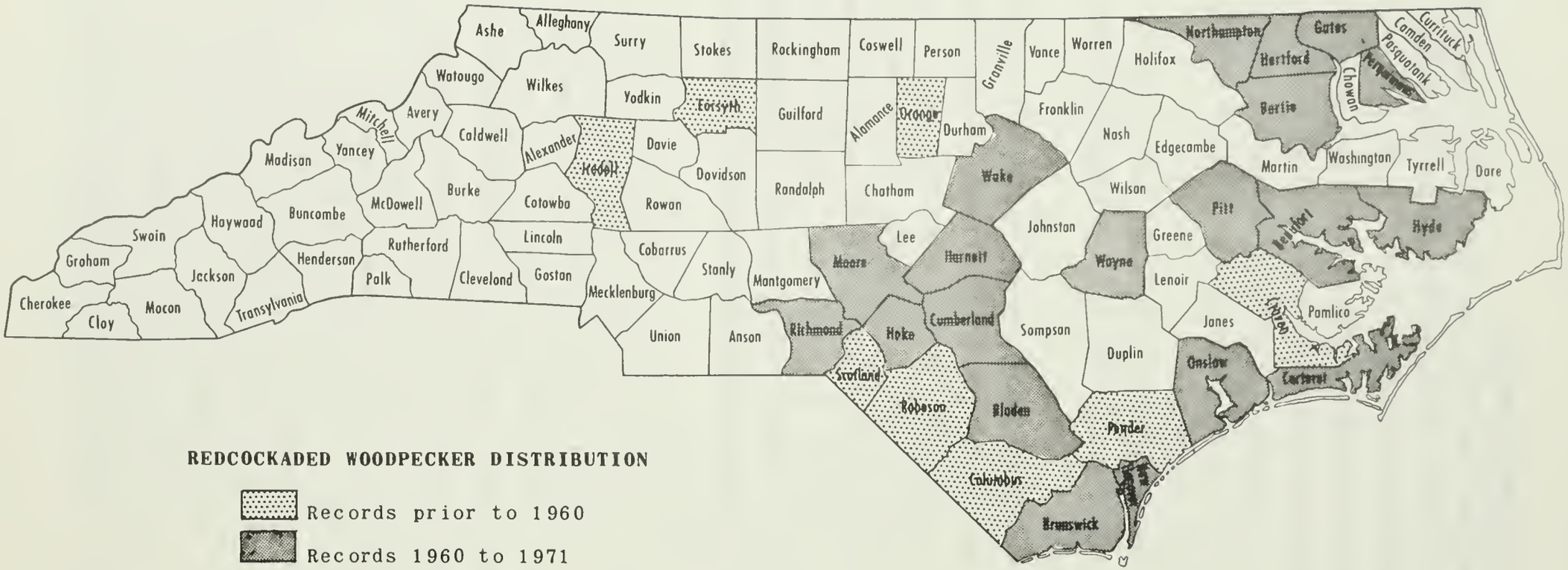
1) Various species of fish, wildlife, and plants have been rendered extinct as a result of economic growth and development untempered by adequate concern and conservation;

2) Other species have been so depleted that they are threatened with extinction;

3) These species of plants and animals are of aesthetic, ecological, educational, historical, recreational and scientific value to the people;

4) The United States has pledged itself, in cooperation with other nations to conserve to the extent practicable the various species of plants and animals facing extinction. In passing this act the Congress established procedures enabling the states to participate in conservation of endangered species through a system of financial assistance and incentives. Legislation drafted for enactment by the 1975 Session of the North Carolina General Assembly provided for delegation of responsibility to the North Carolina Wildlife Resources Commission.

The proposed bill for conservation, management, enhancement and protection of plant and nongame animal species threatened with extinction in North Carolina identified "endangered species" of plants or animals as those whose prospects of survival are in jeopardy due to 1) destruction, modification or curtailment of habitat: 2) overutilization for scientific, educational, commercial, sporting or other purposes; 3) effect on it of disease, pollution or predation; 4) inadequacy of existing regulatory mechanisms; or 5) other natural or man-made factors. It defines and prescribes "conservation" as the use of all methods for the purpose of increasing numbers of wild plants or wildlife up to the optimum carrying capacity of their habitat and maintaining such levels. Said methods include, but are not limited to, scientific resource management activities such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, transplantation, and regulation of taking.




**REDCOCKADED WOODPECKER DISTRIBUTION**

Records prior to 1960

Records 1960 to 1971

Wildlife is defined as any nondomesticated species of the animal kingdom, whether reared in captivity or not, including mammals, birds, fishes, amphibians, reptiles, mollusks, crustaceans, arthropods or other invertebrates.

The bill proposed that the General Assembly find and declare:

1) That is is the policy of this State to conserve wildlife for human enjoyment, for scientific purposes and to insure their perpetuation as viable components of their ecosystems;

2) That threatened and endangered plant and animal species in the State be accorded protection to enhance their numbers; and

3) That the State should assist in the protection of endangered plants and animals resident to other localities by prohibiting and otherwise controlling their shipment into or within North Carolina.

The bill authorized the Commission to establish a list of endangered and threatened species and nongame species in need of management, and to amend it from time to time, after conducting appropriate investigations, consultation with other agencies and holding public hearings. The bill also prohibited (with certain exceptions) the taking, possession, transporting, exporting, processing or selling of listed species and established penalties for violations.

A preliminary listing by the Endangered Species Committee of the Department of Natural and Economic Resources[6] shows 265 species of plants and animals holding tenuous status in our State. The list includes 44 species of plants, 92 invertebrates, 57 fish, 15 amphibians, 9 reptiles, 29 birds and 19 mammals. Of the total, 74 are listed as being rare and 63 as being endangered. The others are listed as peripheral (on the edge of their natural range) or undetermined. The list includes representatives from all parts of the State from the mountains to the sea. It includes representatives from habitats that have been drastically altered, to those that have not yet felt the impact of human intrusion. In some cases the species has probably never been abundant in this State, in other cases it has been virtually extirpated from previously high levels of abundance and distribution.

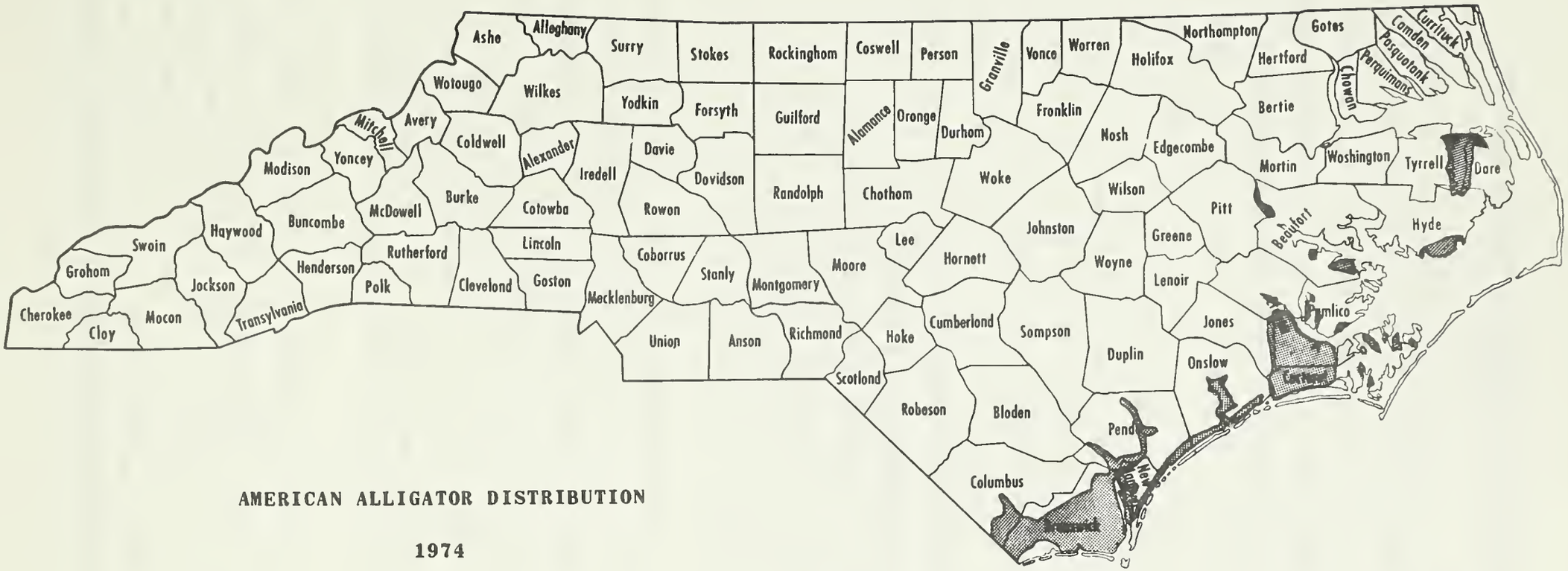
TABLE VII.

SUMMARY TABULATION OF PRELIMINARY LIST OF RARE AND ENDANGERED SPECIES IN NORTH CAROLINA

| SPECIES GROUP | ENDANGERED | RARE | UNDETERMINED | PERIPHERAL AND ENDANGERED | RARE | UNDETERMINED | TOTAL |
|---|---|---|---|---|---|---|---|
| Plants | 10* | 44** | - | - | - | - | 44 |
| Invertebrates | 28 | 16 | 34 | 3 | 8 | 3 | 92 |
| Fish | 12 | 3 | 3 | 21 | 13 | 5 | 57 |
| Amphibians | 1 | 2 | 2 | 1 | 4 | 5 | 15 |
| Reptiles | 2 | 1 | 1 | 1 | 4 | - | 9 |
| Birds | 5 | 5 | 11 | - | 6 | 2 | 29 |
| Mammals | 5 | 3 | 1 | 1 | 2 | 7 | 19 |
| Totals | 63 | 74 | 52 | 27 | 37 | 22 | 265 |

*Classed as rare and endangered.
**Ten of these classed as rare and endangered.

On the county maps in the appendix of this publication, the present distribution of rare and endangered species is plotted to the extent of currently available information so as to enable local land use planning agencies to propose land use classifications in consonance with federal and state laws and regulations. This information is obviously very limited at this time. Hopefully, enactment of state legislation, with necessary funding, will make possible more information about more species in due course. As this information develops and restoration programs ensue, recovery of some species will result in their removal from the critical list. Hopefully also, it may be found that some species, particularly those listed as "undetermined" may be found to exist in numbers sufficient to warrant removing them from the list.




AMERICAN ALLIGATOR DISTRIBUTION

1974

## VII. LAND USE PRACTICES ADVERSELY AFFECTING WILDLIFE

### Forestry

Nearly two-thirds of North Carolina is covered by forests. As such, they constitute the largest blocks of wildLife habitat. It is obvious therefore, that how forests are managed has a strong impact on the welfare of resident wildlife. Generally speaking, the production and harvest of timber can be beneficial to many forms of wildlife. In its development from cutover to maturity, the forest passes through many stages or conditions each of which favors certain wildlife species. Other species, such as cavity-nesting birds and animals require old growth trees. Diversity of forest types and growth stages contributes to diversity and abundance of wildlife.

Forest-based industries such as manufacture of paper, lumber, furniture, textiles and chemicals constitute an important segment of North Carolina's economy. It is, therefore, important that our forests be maintained in a productive condition. While maintenance of forests in a highly productive condition need not be antithetical to production of wildlife, some forest management practices currently in vogue have an adverse impact on wildlife. Most of these can be modified, however, so as to reduce or eliminate their adversity.

Because of their relatively fast growth rate and high productive capacity, certain species of pine are highly favored by the timber industry. Dense stands of pine with no understory of hardwoods, shrubs and vines provide cover but little food for wildlife. This condition prevails from about five to twenty years after planting. During the first five years other plant species are usually abundant and provide food. The developing pines shade these out and the young pine forest becomes a "wildlife desert." After the first thinning there is a reinvasion of food-producing plant species and an improvement of habitat for wildlife. Vast acreages of the "wildlife desert" condition can be prevented if pine plantations are held to small units of about 50 acres and scattered so that the vast acreages of pine are in various age classes with food-producing units intermingled with those that are devoid of food. The high degree of mobility made possible by present-day forestry equipment

contributes to the practicality of this approach.

Another related practice, that we hope is passing out of vogue, is conversion of hardwood sites to pine. The strong resurgence of hardwood on many such sites reduces the practicality of this practice. Particularly damaging to wildlife is the destruction of hardwoods along streams. Leaving hardwood cover along stream courses throughout a pine forest substantially increases the wildlife production capacity of the pine forest.

Broad-scale application of herbicides to destroy hardwoods is a practice that contains an unmeasured potential for biological damage in that there is strong evidence that chemicals used can produce genetic distortion of animal species, in addition to the outright killing of some forms.

Clear-cutting has also been much in the headlines in recent years. We hold no brief against this practice provided that it is conducted in small units of about 50 acres or less so as to maintain diversity of age classes in the new forest. When forests are mature they must be harvested and a new forest started. But we maintain that there is sufficient elasticity in forest productivity to provide for scattering clear-cuts, thereby maintaining a high level of productivity of another valuable crop--wildlife.

Another practice, the damage of which has been too long overlooked, is the felling of trees into streams. Clogging streams with tree tops and other timber residue reduces the capacity of the stream to remove flood waters and contributes to the demand for channelization. It also impedes use of streams for fishing and boating. Sawdust dumped into streams reduces their production of insect life necessary to support fish populations and strongly degrades water quality in other ways.

Construction of logging roads, particularly in piedmont and mountain sections, can severely damage streams through soil erosion and sedimentation. Headwater stream channels should not be used for skidding logs. Logging roads should be built well away from streams and so designed and maintained as to hold to a minimum the movement of topsoil into the streams. In the uplands, firm stream beds of gravel or stabilized fines are the most productive of aquatic life but detritus covered

During fiscal year 1973, 76 fish kills were investigated by Wildlife Commission personnel. Over 250,000 fish, weighing a total of nearly 12,000 pounds, were recovered but probably many more were killed.

bottoms are the most productive in lowland streams. Stream beds covered with shifting sands and topsoil reduce production of lesser fauna that support fish. Highly turbid waters can suffocate fish eggs and reduce the feeding ability of species that find food by sight. Mineral turbidity also reduces penetration of sunlight and reduces production of microscopic plant and animal life at the base of the food chain.

**Farming**

Over a fourth of our State land area is devoted to farming. Generally, these are the most productive upland sites and therefore, they have a great potential for production of wildlife as well as agricultural crops. It is obvious then, that the pattern of farm land use, the crops produced, and the procedures used in their culture, have a controlling influence on the amount of wildlife that is produced.

As in the case of forestry, most farm crops produce side-benefits for wildlife. Some crops such as soybeans, corn, peanuts and small grains are especially beneficial, while others such as pasture, cotton and tobacco are of lesser value. Also, as in the case of forestry, the size of individual fields and their pattern of distribution have a strong influence on productivity of wildlife. Small fields separated by hedgerows of brushy cover offer the highest potential for most forms of wildlife. Except for doves and waterfowl, which use the centers of large expanses of grain fields, most forms of wildlife prefer cropland edges where there is quick access to cover for escape from predators.

The past two decades have witnessed significant changes in North Carolina farming that have had observable impacts upon wildlife--some beneficial and others adverse. We have no argument against increased agricultural production to feed our own growing population and those of other nations. In many cases however, slight modifications can help produce larger quantities of wildlife crops as well as conserve soil, water and forest resources.

Among the farming practices that have had the most serious adverse effect upon wildlife resources may be listed 1) the use of

chemicals to control pests, 2) channelization of streams to accelerate drainage and 3) clearing of vast acreages of woodland habitat.

The development of chlorinated hydrocarbons and other pesticides to control agricultural pests has created one of the most serious threats to many forms of wildlife. Consumption of contaminated plant parts and organisms that have been killed by pesticides has had a devastating effect on songbirds and game birds and animals that is well documented elsewhere. As a result of these impacts, as well as similar impacts upon human health, some forms of insecticides have been banned from agricultural use and restrictions have been placed on others. Continuing research indicates however, that even stronger controls are necessary to safeguard not only wildlife but also human health. As indicated earlier in this manual, similarities between the physiology of wildlife and that of man establishes wildlife as a sensitive environmental barometer. Chemicals that can kill wildlife can also kill man. It is therefore essential that use of chemicals in agriculture come under increasingly close scrutiny if we are to preserve the quality of our environment for all living creatures, including man.

Stream channelization through federally financed agricultural programs is a practice that has become of increasing concern to wildlife interests during the past decade. The reason for this concern is that, as originally designed, these projects have the effect of destroying hardwood swamps. In addition to their intrinsic value, hardwood swamps constitute highly valuable habitat for many forms of wildlife. If we had unlimited acreages of such sites, we could afford to spare some of them, but the hard fact is that we have only a very limited acreage of these habitats and their elimination would constitute a serious blow to the State's wildlife resources. Furthermore, hardwood swamps have other values that augment the importance of their preservation. They produce valuable hardwoods that are important to our furniture industry; they serve as detention reservoirs to hold back the impact of floods and allow silt to settle; they serve as underground aquifer replenishment areas; they serve as filters to purify water supplies and at the same time produce microscopic flora and fauna that nourish higher forms of life in our streams and estuaries.

Sedimentation loads are especially heavy in recently channelized streams and bank erosion sustains downstream silt burdens for years after construction. Accelerated run-off results in periodically inadequate water for fishes and removal of shade results in excessive heating. These factors, added to the destruction of all shelter and most food producing areas--plus the shifting unstable bottom--drastically reduce fish producing capacity.

Hopefully, we are about to turn the corner on the widespread implementation of this practice. There is some evidence that in some cases the effect desired by agricultural interests can be attained by clearing and snagging wooded stream channels--removing tree tops and logs that impede the natural flow of water. Studies demonstrate that while channelizing a stream destroys its fish-producing capacity and drains the swamp, clearing and snagging is less damaging, and at the same time helps to accelerate the removal of surplus water from adjoining croplands.

A third agricultural practice of concern to wildlife interests is one more recently initiated in response to the world food situation. This involves the clearing, draining and conversion to farm land of vast acreages of eastern wetlands. If continued at projected rates, this will have the effect of extirpating wilderness species such as the black bear and bobcat from several eastern counties. It also creates the possibility of soil loss through wind erosion and oxidation. The areas being cleared have largely organic soils which are particularly susceptible to both forms of damage. The likelihood of such development raises questions about the longevity of such ventures and their net cost-benefit ratio to the people of our State. Even if profitable in the short run, soil subsidence will increase the need for accelerated drainage, presumably by pumping, and we may well expect eventual abandonment with the land left in a deteriorated condition. In their present condition these areas produce timber as well as a form of wildlife in short supply that provides hearty outdoor recreation for a hardy segment of our sportsmen. This type of program raises fundamental questions of philosophy and policy--how much of an obligation do we have, as a nation, to encourage the further proliferation of human populations in other parts of the world, thereby reducing the quality of life here at home?

Over the long run, one of the most serious adverse impacts of farming practices on aquatic wildlife resources is the erosion of soil and the resulting sedimentation of streams. While erosion control practices have been developed and used in most parts of the State, it appears inevitable that plowing and cultivating will continue to result in erosion of soil. Soil scientists have determined that on the

average, we can afford to lose four tons of soil per acre per year since we can expect conversion of that volume of substrate to topsoil annually. While even this rate results in serious reduction of stream productivity, a much greater rate of erosion is the rule in most localities. It is obvious that there is still room for a great deal of improvement in development of agricultural land use practices that will further reduce the erosion of topsoil--particularly in Piedmont and Mountain counties.

Another group of farming practices worthy of mention may be grouped under the heading of field borders. The development of heavy duty farm machinery has considerably expedited clean farming and at the same time larger fields increase the profitability of machine use. As mentioned above, this has largely eliminated the "patch farming" of earlier years that was characterized by smaller fields and shrubby fence rows. These shrubby fence rows helped produce an abundance of wildlife, including songbirds, that virtually controlled insect depredations. We would speculate that elimination of shrubby field borders contains an unrecognized increase in cost of pest control, and that this cost could be reduced by allowing field borders to revert to shrubby growth. Even the large fields in the eastern part of our State provide such opportunities in that most of them contain drainage ditches. If these ditches were allowed to develop shrubby banks, they would produce insect-controlling wildlife and also reduce soil erosion. This practice, we believe, would be particularly appropriate in the organic soil farm lands in coastal counties. In these locations, it would be helpful to allow tree growth in such borders so as to reduce wind erosion of the soil.

**Urbanization, Industry, Transportation**

Nearly ten percent of North Carolina's land area is covered by cities and towns, with their industries and connecting highways. Use of land for these purposes has been increasing not only because of increasing population but also because of increasing urbanization of our society. During the past two decades there has been an accelerated movement of people from sparsely settled rural areas to cities and towns. People are being pushed from the land by increasing

mechanization of farming and pulled to the cities by increasing industrialization. Increasing affluence has, in turn, resulted in development of second homes and vacation homes in remote wilderness areas. Along with these trends has been a press for more and wider highways, and each of these trends has resulted in greater stress upon wildlife resources.

Urban sprawl reduces wildlife range. Suburban developments, trailer parks, and industrial plants are springing up in formerly favorite hunting areas around our towns and cities. Vacation communities and second homes particularly along the coast and in the mountains are invading formerly wilderness areas. In those locations where game species persist in spite of human intrusion, concern for human safety militates against continuation of hunting. More and faster highways result in increasing tolls of both big game and small game as well as other forms of wildlife.

Accelerated urbanization and industrialization brings with it expanded problems of waste disposal that can adversely affect wildlife resources. Inadequately treated domestic sewage released into rivers and streams reduces the ability of the waters to support fish and wildlife. Excessive amounts of biodegradable effluents consume the oxygen resulting in suffocation of fish and other organisms as well as rendering inedible those that are able to survive. Storm sewers dump excessive amounts of coal tar derivatives from pavements into waterways as well as sand and silt that diminish productivity of microorganisms, benthos, and plankton that fish feed upon. Disposal of solid wastes in land fills results in leachates that also contaminate streams. Industrial wastes--solid, liquid and gaseous--result in contamination of land, water and atmosphere. Heavy metals such as mercury find their way into water-based wildlife rendering their flesh dangerous for human consumption. Atmospheric contaminants that kill vegetation undoubtedly have some, if as yet unmeasured, adverse effect upon animals as well as plants.

Mining activities frequently result in silting of streams to such an extent as to render them incapable of supporting many species of fish that would otherwise inhabit them. Fertilizer plants release chemicals that result in eutrophication of rivers and

Gravelling operations in stream beds destroy the organisms in the reach of streams being mined and also contribute large volumes of silt that reduce productivity of downstream reaches.

estuaries. Textile plants and paper mills release dyes, lignin and other chemicals that reduce penetration of sunlight into water thereby reducing their productive capacity as well as making fish inedible. Release of heated water used for cooling purposes by power plants into reservoirs raises the temperature of fish-producing waters to lethal levels. Highway construction and maintenance results in siltation of streams and invasion of wild areas.

Increasing urbanization also results in other disruptions of natural waterways. Construction of buildings and roads in floodplains not only invites damage to such structures in times of flood but also reduces the capacity of the land to accommodate normal rain water thereby further aggravating flood conditions downstream. Such topographic situations are highly productive of many forms of wildlife and should be reserved for conservation of water, wildlife and timber. Impoundments on free-flowing streams preempt large acreages of ideal wildlife habitat not only at the impoundment site but also downstream since the flood-controlling effect of the impoundment invites clearing and development closer to the stream below the dam. Ditching of marshes for mosquito control reduces their capacity to produce wildlife. In many places shallow impoundments would more effectively control the mosquito while at the same time increase production of furbearers, water-fowl, fish, crabs and other wildlife. Dredging and filling of marshes for construction of residences and marinas further reduce the area of wildlife habitat and render adjoining areas of habitat unusable by wildlife. Great benefits would result from a revision of the ways in which our society traditionally has handled water resources and stream flood plains.

## VIII. WILDLIFE DAMAGES

The amount of damage inflicted by wildlife on crops and property in North Carolina is relatively insignificant. Reports are received occasionally about isolated cases but they are rare. In many cases injured parties do not report damage because other values derived from the marauding wildlife exceed the damage committed by it. Sometimes this is in the form of monetary compensation but in other cases the "value" received is merely the pleasure of having the wildlife at hand and having the opportunity to observe it. It is sometimes suggested that a system be established to provide compensation for wildlife damage but this poses so many problems related to assessment, funding and equitability that most states have avoided it. It is generally conceded that such programs would not be worth their cost.

Years ago, when farms were much smaller and the family farm was in vogue, there was greater opportunity for substantial damage to an individual farm operation. The recent great increase in size of farm units with its increase in field size and reduction of cover, has significantly reduced the opportunity for crop damage by most forms of wildlife. As a result, the State Wildlife Commission receives very few complaints of crop depredation.

### Blackbirds

The large fields developed by modern agriculture, particularly of soybeans and corn, appear to have encouraged the development of huge flocks of blackbirds. These can be damaging to late-maturing crops but usually crops are harvested before the large flocks develop. The most serious crop damage committed by blackbirds in North Carolina is reported to be pulling up recently germinated corn, and reports have been received of damage to blueberries. Blackbird crop damage is to some extent mitigated by their consumption of weed seeds and insects. Blackbird roosts near residential areas can be a serious nuisance, and when roosts are located near airports the flying birds constitute a serious hazard to aircraft.

### Hawks and Owls

At one time, it was felt that hawks and owls were adverse to

farming interests because of their taste for poultry. Studies have found, however, that hawks and owls feed primarily on mice and while they might take an occasional chicken, their net effect is beneficial in keeping rodent populations under control. Furthermore, mass production of poultry under cover has largely replaced the production of barnyard fowl so there is relatively little opportunity for this type of depredation. All hawks and owls are protected by State law and have responded by a significant increase in numbers over the past several years.

**Deer**

Most of the crop depredation complaints received by the Wildlife Commission are from damage committed by deer--usually to soybeans, less frequently to peanuts, and occasionally to corn or other crops. Studies here and elsewhere have amply demonstrated that the most effective control is through deer herd management by harvest of deer of either sex through carefully regulated hunting seasons. Frequently, however, landowners receive such good fees for deer hunting rights that they prefer to sustain high deer populations, along with their damage, rather than reduce the population through either-sex hunting. As indicated elsewhere, deer populations and crop depredation are at their highest levels in the northeastern part of the State and this is where most of the either-sex deer hunting is scheduled.

**Bear**

Black bears have been reduced to such a small remnant of their former population that it is almost unfair to accuse them of any wrong-doing. From the bear's point of view, it is man's intrusion into his territory that causes the damage. Planting corn next to the few remaining vestiges of bear habitat has the inevitable result of tempting the bear to feed upon it. Setting a bee stand in the midst of his terrain is virtually asking for a confrontation. While public sentiment in favor of the bear has, by law, closed the bear season in some counties, it still allows the killing of marauding wildlife. A more practical solution to this problem is protection of the bear by establishing smaller sanctuaries closed to hunting.

The rest of the county could then be open to bear hunting so as to provide an opportunity for population control through recreational pursuit during the hunting season.

**Raccoon**

Raccoons have a well developed taste for corn on the cob and take advantage of plantings that are close to their natural habitat. Sometimes the damage committed by this minor masked bandit is blamed on the bear and in years past has served as an excuse for out of season bear hunting. Also, farmers suffering raccoon damage welcome coon hunters who wish to conduct mid- and late-summer 'coon dog training and field trials. Complaints about raccoon damage, traditionally centered mostly in eastern counties, have spread upstate well into the Piedmont in recent years. However, inflated fur prices starting in 1972 have substantially increased the take of raccoons by both hunters and trappers and the problem has somewhat abated.

**Bobcat**

Bobcats occur statewide in extensive timbered areas and at one time constituted a menace to barnyard poultry within their range. Abandonment of poultry production as an adjunct to farm living brought about by more efficient mass production methods has largely removed poultry from the bobcat's diet. Occasionally, however, reports are received of turkeys lost to bobcats when they are raised near extensive timbered areas. The particular individuals causing this damage can be caught in traps and, thus, they do not constitute a significant hazard to turkey producers.

**Foxes**

Both red and grey foxes have a taste for poultry when available. Foxes are much more widely dispersed and abundant than bobcats, but here again, the abandonment of casual poultry production on most farms has largely removed the conflict between the fox and the farmer. It is generally agreed that the large numbers of mice consumed by foxes makes them more a friend than a foe of the farmer.

**Squirrels**

Cornfields abutting hardwood forests provide favored fall feeding areas for squirrels, as most squirrel hunters know. Early picking and mechanical drying of corn has substantially reduced exposure to this type of depredation. Complaints are rarely received, probably because the damage is usually negligible in quantity and is often recovered in the form of Brunswick stew.

**Rabbits**

Those few complaints that are received about damage by rabbits usually come from home gardeners who are reluctantly sharing the fruits of their toil with rabbits nesting near the garden. Household pets--cats and dogs--are probably the best controls, petless people resort to commercial repellants or box trapping. Occasionally, reports are received from commercial timber producers of damage to planted pine seedlings since highly fertilized seedling stock appears to be especially attractive to both cottontails and marsh rabbits. Such damage is usually limited to small areas and does not constitute a serious handicap to timber producers, especially since a buildup in rabbit populations in such locations usually attracts foxes and other predators that help restore the desired "balance of nature."

**Mice**

Several species of mice, such as the meadow mouse, the deer mouse, the cotton rat, and others at times build up to significant damaging levels in apple orchards and graineries. Reports have also been received from foresters whose aerial tree-seeding attempts have been frustrated by an abundant microtine population. Coating seeds with repellants appears to have solved this problem. Similarly, control of nesting cover and applications of rodenticides have largely removed the rodent threat to orchards and graineries. To the mouse's credit, on the other hand, recent research on gypsy moth control has indicated that they can effect significant control on this pest by feeding on the ground-wintering larvae. In most cases the natural control by wild predators such as foxes, bobcats, hawks and owls help to hold mouse depredations under control.

**Beavers**

By the early 1900's the beaver was extirpated from this State. Restoration by well meaning lovers of nature has resulted in landowner-beaver conflict at scattered locations. In addition to flooding of valuable timberland, resulting in the killing of timber by both inundation and feeding, beavers sometimes plug culverts thereby flooding rural roads. Damage is best controlled by trapping during the winter months and the statewide problem is relatively insignificant. Some landowners feel that beaver damages are more than compensated by the attractiveness of their impoundments for waterfowl and by their control of erosion and runoff.

**Exotics**

Several exotic species have found their way into North Carolina that have a potential for causing damage to landowner interests. These include four mammals (house mouse, barn rat, roof rat and nutria), four birds (English sparrow, starling, pigeon and monk parakeet) and three fish (grass carp, piranha and walking catfish). The three small rodents and the pigeon are usually associated with human habitation and are usually susceptible to control by killing or habitat control. The piranha and walking catfish are pet shop items and probably cannot survive wintertime water temperatures in North Carolina. The other species, with the possible exception of the monk parakeet, have joined the ranks of our native fauna.

The **nutria**--a beaver sized rodent native to South America--was brought into Currituck County in the mid-forties by fur trappers who hoped to reap a bonanza from sale of pelts. Hoped-for pelt values never materialized but the nutria has prospered and is spreading to the detriment of muskrats and waterfowl with which it competes for food. Poison controls developed in other states are unlawful in North Carolina and legal control is restricted to trapping and shooting.

The **English sparrow** and **starling** were introduced from Europe many years ago. The former proliferated to pest proportions in municipal areas during the horse and buggy era but its prime source of food was eliminated by the automobile. Starlings have joined the ranks of other blackbirds in rural areas where its grain eating proclivity is

somewhat mitigated by its consumption of weed seeds. The **monk parakeet** is a more recent arrival and only a few sightings have been reported. Surveillance and control of these few individuals will probably prevent its emergence as a threat to our fruit industry.

Fish pond owners seeking an easy remedy to excessive pond vegetation have introduced the **grass carp** at scattered locations. Results have been disappointing. They reduce production of natural fish foods by creating excessive water turbidity through their bottom rooting feeding habits and they do not control the unwanted vegetation.

## IX. LAND USE PRACTICES FAVORING WILDLIFE

### Farming

Most farm crops are utilized for food and cover to some extent by wildlife. Benefits are of course seasonal and supplementary to natural food and cover. With few exceptions, cropland use by game birds and animals is largely restricted to field borders where there is quick access to protective cover afforded by natural vegetation.

Several of our major crops--corn, small grains, soybeans and peanuts are especially favored to varying degrees by deer, bear, turkey, raccoon, quail, squirrel, doves, waterfowl and songbirds. Late harvest and spring plowing (as opposed to fall plowing) extend the period over which wildlife can utilize crops and crop residues. Fencing cattle out of woodlots results in more wildlife food and more effective wildlife cover, as well as preventing soil compaction, erosion, and stream siltation. Crop diversification and rotation provides diversification of food and cover. Hog lots provide favored feeding places for doves. Pastures are grazed by deer, and turkeys use them for feeding on grasshoppers and other insects.

Cover afforded by shrubby fence rows, ditch banks, wildbreaks and stump windrows pull game birds and animals as well as other wildlife out into croplands to considerable distance from forest cover. Turning strips at field borders provide nesting cover and unmowed fallow fields provide ideal roosting cover for quail as well as feeding and resting areas for other forms of wildlife.

Erosion control practices not only conserve soil but also reduce sedimentation of streams--the number one deterrent to fish production in our free-flowing waterways. Sod waterways, sod planting of corn, strip cropping, windbreaks, crop residues and delayed plowing all contribute to soil retention and improved conditions for wildlife.

Many landowners cooperate with the Wildlife Commission by accepting and planting special seed mixtures that produce food and cover for wildlife Some of these are annuals that can easily fit into crop rotation patterns while others are perennials that can be planted in odd corners that are not convenient to crop. Some, like shrub lespedeza will persist for 20 years or longer. Others, like sericia lespedeza, provide cover for nesting and roosting in field border turning

Some wildlife, and hunting, can be preserved on the large farms in eastern North Carolina if some of the windrows of stumps and logs are allowed to remain. When allowed to grow shrubs and trees, these windrows also serve as "breaks" which reduce soil loss through wind erosion.

strips. The Commission has distributed these materials (free of charge) along with on the ground assistance in selecting planting locations, to over 5,000 landowners each year since its establishment in 1947.

**Forestry**

The surge of new growth following timber cutting, particularly clear-cutting, usually provides excellent food for deer and prime cover for most species. Except for nesting cover, turkeys normally shun the dense growth following clear-cuts, presumably because of its impediment to escape flight. Smaller birds such as quail and grouse are not so impeded and they use such thickets to escape pursuit. Hardwood forests that support our furniture industry are particularly beneficial to most forms of wildlife because of the large variety of fruits and nuts that they produce. Each of the many species of oak and hickory produce highly prized mast that is eagerly sought by bear, deer, boar, turkey, squirrel and grouse as well as the lesser rodents of the forest floor. Sweet gum and poplar seeds are eagerly sought by squirrels, quail and grouse. Black gum fruits are prized by black bears. Understory trees and shrubs such as dogwood and gallberry also produce highly favored fruits.

Prescribed burning of pine stands for the purpose of reducing fire hazards and controlling tree diseases results in volunteer growth of wild legumes, the seeds of which are highly favored by quail and songbirds. The fresh growth of wire grass is also more palatable to deer than the tough old tufts. Preservation of abandoned home place clearings with their plum and blackberry thickets as well as other fruit bearers can further enhance wildlife habitat with minimum sacrifice of timber producing area. As indicated above, the most significant modification of pine forestry for wildlife is interspersion of small blocks (50 acres) of varying age classes so as to maintain both food and cover throughout the forest. Waterways that lace pine lands normally support various species of hardwoods, allowing them to remain enhances the areas's ability to support wildlife.

While forestry does not produce the annual stream siltation load resulting from agnicultural tillage, periodic logging does carry such

Prescribed burning prevents wildfires by preventing the accumulation of fuel and also stimulates the growth of wild legumes and other vegetation that are of benefit to wildlife.

hazard. This can be substantially reduced by proper placement of skid trails and logging roads particularly in the Piedmont and Mountain regions of the State. Seeding of logging roads and log decks to fescue and other grasses not only reduces erosion and stream siltation but also creates additional food for deer and turkey.

**Water Management**

The urgency of protecting water supplies for both domestic and industrial use has emerged in recent years as one of the most challenging conservation issues. In many localities the unavailability of water is the prime limitation to expansion of human habitation. It is equally important for wildlife. It is our belief, and strong recommendation, that floodplains and waterways should be dedicated to conservation of water, timber and wildlife. Recent research is also demonstrating that disposal of partially treated sewage effluent on land adjacent to floodplains, rather than directly into the stream can result in many benefits. Such disposal can substantially reduce cost of treatment in that filtration through the soil acts as the final cleansing procedure. Nutrients in the sewage are taken up by the trees and lesser vegetation thereby accelerating production of timber, increasing production of fruits and improving cover for wildlife. By the time the water gets back to the stream, the surplus nutrients have been removed and degradation that results from dumping directly into the stream is prevented. While research on this procedure is still in progress, results demonstrated to date indicate that benefits to the land may be sufficiently great to make it unnecessary to purchase lands for sewage disposal. Land use planners and others concerned with waste water management are strongly urged to study the feasibility of implementing this procedure.

Clean, free-flowing streams are one of our most important natural resources. Even small headwater streams too small to support fish life, and intermittent streams that flow only during wet periods, are important components of our waterways. Nutrients that are washed from the land into these headwater tributaries produce an abundant micro-fauna and micro-flora that wash down into the larger streams

where they serve as food for aquatic insects and other organisms that support fish life. Streams large enough to support fish, mussels, crayfish, mink, otter and raccoon are most productive when they are free flowing over well stabilized natural bottoms with intermittent pools and riffles. Natural streams, unimpacted by human activity are self-cleaning and self-sustaining. Human activity along streams should be restricted to removal of the impact of human influences and natural catastrophes such as hurricane windthrown trees. We need much stronger implementation of laws prohibiting the felling of trees into water courses. Prevention of such obstructions reduces the need for channelization to accelerate removal of water from farm land and developed areas.

Impoundment of streams and rivers has become a necessary adjunct to civilization. At one time impoundments were required to provide sustained water supply for irrigation and human consumption. Today impoundments are also needed for power generation, flood control, municipal water and recreation. Even with impoundments, however, it now appears that the limits of available water supplies are being reached in many locations. The problem is of course aggravated by inadequate removal of waste materials from water returned to streams, thereby resulting in contamination of water supplies. Further aggravating the problem is the fact that each new impoundment seriously diminishes prime wildlife habitat and high quality timber production sites, both of which are in short supply. Also, the creation of impoundments encourages clearing of downstream reaches for agricultural, residential and industrial development, frequently within the normal floodplain of the stream. As history has shown, development of floodplains results in greater loss in times of high water and greater public liability through flood damage relief and similar programs.

The adverse impact of impoundments on wildlife can to some extent be mitigated by acquisition of lands beyond those needed for water retention and dedicating them to wildlife, timber conservation, outdoor recreation and similar purposes. In some cases the dam and spillways can be set at elevations that will provide for shallow water subimpoundments on tributary streams that can be managed for waterfowl food production. In all cases measures should be taken

Clear-cutting timber in small patches adds to the diversity of wildlife food and cover.

to ensure minimum downstream flows adequate to sustain fish life. Consideration should also be given to include in the acquisition appropriate downstream reaches that will ensure perpetual production of timber and wildlife and to accommodate surplus waters from unusually heavy rainfall.

The several thousand farm ponds that have been built in North Carolina over the past 40 years constitute one of the best land use practices for wildlife. They support a valuable fish resource as well as fur bearers and water loving birds, not to mention their benefits in curbing soil erosion and stream siltation.

Impoundment of coastal marshes, a relatively recent practice, has been demonstrated to be an excellent method of creating both breeding and wintering waterfowl habitat while at the same time limiting production of salt marsh mosquitoes. The recent revelation of the contribution of *Spartina* marshes to estuarine ecosystems tips the balance against their impoundment. However, needlerush marshes, being somewhat higher in elevation, contribute at a lesser rate to estuarine nourishment and they could possibly be more productive if impounded and periodically flushed, as is necessary for proper management.

"Greentree reservoirs" are another form of impoundment that are highly beneficial to waterfowl and other wildlife in coastal wooded wetlands. These are managed to hold water only during the winter months and are highly attractive to wintering waterfowl. Furthermore, inundation appears to accelerate growth of certain valuable hardwoods such as gums and oaks.

**Development**

Residential development, while not adapted to production of huntable wildlife, can be so designed as to attract many forms that can enhance the quality of life through observation. Cluster development, which provides for retention of wooded areas, furnishes acceptable habitat for many songbirds as well as quail, squirrels and rabbits. Dedication of stream courses and floodplains to greenways and parks enhances the attractiveness of communities and provides opportunities for outdoor recreation within the municipality. Parks,

and trees planted along city streets, in addition to housing an abundant bird life help to cleanse the air of pollutants. Recent enactment of soil erosion control legislation as related to construction projects should help materially to maintain stream quality in and near urban areas. Recent enactment of laws and regulations prohibiting development in floodplains has been long overdue.

Rural setting of manufacturing plants can impinge upon hunting territory but landscaping can be designed to benefit nongame wildlife and thereby contribute to quality of human life. New industries should be screened not only on the basis of economic considerations but also on the basis of water demand and effluent control. The nature of their waste products should be carefully scrutinized and environmentally sound disposal procedures required. If and when an oil industry is established it should be done with built-in safeguards against oil spills and other contamination.

Transportation and communication routes whether they be highways, railroads, power lines or pipelines can be designed to safeguard and even enhance wildlife resources. We cannot emphasize too strongly that new or improved highways should follow existing routes. Our fast diminishing wilderness areas should be spared further fragmentation. Major highways are usually well landscaped but rural roads in too many places constitute a primary source of stream polluting silt. All road banks should be stabilized with grass, lespedeza or shrubs. The annual scraping of rural road shoulders should be stopped.

Power and gas lines through rural areas have been described as unsightly by some, but we see them as providing diversity to wildlife habitat. Some power companies have initiated the highly commendable practice of seeding power lines with wildlife habitat improvement planting materials and this practice should be further encouraged. The same has been done on gas lines passing through game lands but it should be done elsewhere also.

## LIST OF REFERENCES

(1) Anonymous. 1967. Outdoor Recreation Trends. U. S. Department of the Interior, Bureau of Outdoor Recreation.

(2) Anonymous. 1970. National Survey of Fishing and Hunting. U. S. Department of the Interior, Fish and Wildlife Service Resource, Publication 95.

(3) Anonymous. September 1974. Bulletin of Sports Fishing Institute. Washington, D. C.

(4) Arbrey, Robert. 1966. The Territorial Imperative. Kingsport Press, Kingsport, Tenn.

(5) Carson, Rachel. 1962. Silent Spring. The Riverside Press, Cambridge, Mass.

(6) Endangered Species Committee. 1973. Preliminary List of Endangered Plant and Animal Species in North Carolina. N. C. Department of Natural and Economic Resources.

(7) Fish, Frederic F. 1967. Some North Carolina Fresh-Water Fishes. N. C. Wildlife Resources Commission.

(8) Fish, Frederic F. 1974. The Sport Fishery Statistics from the Inland Fishing Waters of North Carolina, 1970-71. Federal Aid in Fish Restoration Project F-19, Final Report. N. C. Wildlife Resources Commission.

(9) Hamilton, Richard. 1973. Statewide Mail Survey of North Carolina Hunters. Federal Aid in Wildlife Restoration Project W-56-1 Annual Report. N. C. Wildlife Resources Commission.

(10) Horvath, Joseph C. 1974. Economic Survey of Wildlife Recreation. Environmental Research Group, Georgia State University, Atlanta, Ga.

(11) LaSalle, Richard N. and Knight, Kenneth L. 1974. Effects of Salt Marsh Impoundments on Mosquito Populations. Water Resources Research Institute Report No. 92. N. C. State University, Raleigh, N. C.

(12) Pearson, T. Gilbert, et al. Revised by David L. Wray and Harry T. Davis. 1959. Birds of North Carolina. N. C. Department of Agriculture.

(13) Wildlife Management Institute. 1973. North American Wildlife Policy. Washington, D. C.

(14) Profile of North Carolina Counties. 1973. Statistical Services Section, Office of the State Budget, N. C. Dept. of Administration, Raleigh, N. C.

(15) Cost, Noel D. 1974. Forest Statistics for the Southern Coastal Plain of North Carolina 1973. Forest Service Resource Bul. SE-26. Southeastern Forest Experiment Station. Asheville.

(16) North Carolina Conservation Needs Inventory. U. S. Soil Conservation Service. U.S.D.A. Raleigh, N. C.

# APPENDIX

## Introduction

Whereas the text of this bulletin deals with principles of land use planning that are generally applicable for the entire State, the Appendix is limited to information which applies to only those 20 counties that are subject to the provisions of the Coastal Area Management Act of 1974.

The Appendix contains information on wildlife resources in each of the 20 counties, which may be summarized as follows: 1) a narrative summary of the wildlife, fisheries and endangered species present, 2) a map delineating certain important wildlife habitat types and also showing utilization of inland fishing waters by certain species of fish and by fishermen, and 3) a tabulation of man-days of hunting recreation expended for each of the major game species during the 1972-73 hunting season. Each of these is further described as follows:

The **narrative summary** provides information on the relative abundance of each of the major species of game animals, game birds and furbearers. Omission of a species from this narrative indicates that it is either absent or does not occur in significant numbers. For localized species, occurrence in the county is given.

No attempt was made to list each species of fish that occurs, rather, percentage estimates of the major species or groups of fish taken by fishermen is given. These are based on data obtained from field interviews of fishermen made by the Commission's staff of wildlife protectors during the period April 1, 1970 and March 31, 1971. The complete final report of this study[8] is available to those who feel that more detailed data are required for their purposes in land use planning.

Relatively little definitive information is presently available on the status and distribution of those species of plants and animals that are classified as rare and/or endangered. The most recent and complete information is a preliminary list for North Carolina[6] prepared by a special 19-man committee comprised of natural resources specialists representing several fields of study. The Wildlife Com-

mission field staff provided additional information on some of the major animal forms. This list was used as the primary reference in presenting information on rare and/or endangered species for the respective counties involved; however the species list for each county is not to be considered complete, especially for species classed as rare or "undetermined."

**Maps of Certain Wildlife Habitat Types and Freshwater Fisheries:** The wildlife habitat types which are delineated on county outline maps are only those vegetative types which are considered to be of particular importance and which warrant special consideration in land use planning. The types shown are bog and pocosin; wooded swamp; regularly and irregularly flooded salt marsh; and shallow fresh marsh. Special consideration of these habitats is indicated for several reasons. These areas are "fragile" in that they are subject to alteration by man's activities. They are in relatively short supply and are commonly found only in the Coastal Plain. They are of high value as they provide essential habitat for certain forms of wildlife--waterfowl and black bear being two examples in point. Also, these habitats afford sanctuary or some other key habitat component which contributes to the survival and abundance of those wildlife forms which are common to other adjoining habitats.

The watercourses and lakes that are shown on the above maps are not intended to represent all of the fishery habitat which exists in a particular county. Only the more important areas of fishery habitat are shown, including both inland and estuarine waters which are or primary importance to the freshwater fisheries resources. The waters are utilized by both freshwater and anadromous species for spawning, spawning runs, or day to day occupancy. Some indication of such "multiple use" is demonstrated by application of more than one symbol to some watercourses. Areas of high usuage by fishermen are also plotted. Most of these waters have been inspected and characterized by the Commission's fish biologists. These characterizations are summarized in Table VIII.

**Man-Days of Hunting Recreation:** Estimates of the total man-days of hunting recreation for the major species of game are tabulated for each county. These estimates are based on habitat acreages

TABLE VIII.

ECOLOGICAL TYPE CLASSIFICATION
OF NORTH CAROLINA STREAMS

| | WIDTH | DEPTH | FLOW | SUMMER TEMP. | TURB. | BOTTOM | ALK. pH | FAUNA | OTHER |
|---|---|---|---|---|---|---|---|---|---|
| 1 Dace Trickle | 0-5' | Shallow few pools | 0-1 cfs | Varies | Clear | Sand, gravel, boulders | Varies | Dace, Shiners | Most Headwater Piedmont and Coastal streams |
| 2 Robin Warmouth | 0-30' | Mod., abundant pools | 0-50 | Warm | Varies | Sand, muck, silt | Varies | Robin, other Centrarchids, Creek Chubs | Typical medium size Piedmont stream |
| 3 Largemouth | Over 10' | Mod., long, deep pools | Over 20 cfs | Warm | Varies | Gravel, silt, muck | Varies | L.M.B., Suckers, Bullheads | Mod. sized upper Piedmont and some Coastal Plain streams |
| 4 Largemouth Pickerel | Over 10' | Mod., deep pools | Over 5 | Cool | Clear | Predominantly sand | 10 6 | L.M.B., Chain Pickerel, Robin | Blackwater upper Coastal Plain streams. Highly stained |
| 5 Catfish Sucker | Over 10' | Mod., deep pools | Over 5 | Warm | Varies | Boulders, rubble, silt | Varies | Suckers, Catfish, various Cyprinidae | Mod. sized, unpolluted upper Piedmont streams |
| 6 Carp Catfish | Over 50' | Deep | Over 30 | Warm | Turbid | Silt, muck, boulders | Varies | Carp, Catfish | Larger, slow-flowing rivers of Piedmont and Coastal Plain |
| 7 Smallmouth | Over 10' | Mod., abundant pools | Over 5 | Cool | Norm. Clear | Boulders, rubble, gravel | Varies | Smallmouth, Rock Bass, Crayfish | Mod., sized mtn. streams. Generally sections immed. below trout water |
| 8 Sucker Stream | Over 20' | Moderate | Over 10 | Cool | Varies | Boulders, rubble, silt | Varies | Suckers, Robin, Warmouth, Rock Bass | Lower reaches of some trout streams |
| 8(a) Stoneroller Hog Sucker | Under 20' (0-20') | Shallow to moderate | Varies | Cool | Varies | Boulders, rubble, silt | Varies | Stonerollers, Dace, Suckers | Small to moderate size mountain streams in open valleys |
| 9 Trout (a) Feeder | 0-8' | Shallow | 0-3 | 70 | Clear | Boulders to sand | Varies | Sculpin, Dace, Caddis Flies | Headwater and tributaries to trout streams |
| (b) Brook | 8'-20' | Shallow, many pools | 3-10 | 70 | Clear | Boulders to sand | Varies | Brook trout, Dace | High elev. stream with barriers to upstream migr. |
| (c) Rainbow | Over 10' | Moderate | Over 5 turb. flow | 75 | Clear | Boulders to sand | Varies | Rainbow, Dace, Chubs | Larger streams with heavy, fast-flowing water |
| (d) Brown | Over 8' | Fairly deep, large pools | Over 5 slower vel. | 75 | Norm. Clear | Boulders to sand | Varies | Brown, Chubs, Shiners, Suckers | Low elev. streams with slow flow, deep pools |
| 10 Tidal | Over 20' | Deep | Over 10 | Warm | Varies | Sand, muck, silt | Varies | Bass, Catfish, W. Perch, various anadromous species | Coastal streams influenced by tide |
| 11 Redfin Warmouth | 0-30' | No pool or riffle | 0-20 cfs Imp. | Warm | Clear | Sand, muck, silt | Varies - low | Redfin pickerel, Warmouth, Flier | Swamp drainage stream of Coastal Plains |

**NOTE:** The numbers designating certain streams on the maps identify the ecological types of the indicated waters as listed in this table. Circled numbers on the maps indicate favored fishing waters.

for each game animal, on its estimated productivity, and on the man-days of effort required to make a kill. Habitat acreages were derived from published statistics on agricultural, forested, and urban and industrial lands in the State.[14][15][16] Values for productivity were provided by the Commission's field biologists and values for effort were obtained from the 1972-73 mail questionnaire survey of licensed hunters.[9]

## SUMMARY OF WILDLIFE, FISH AND ENDANGERED SPECIES

### BEAUFORT COUNTY

#### Wildlife

A moderately high deer population occurs throughout the county, with highest densities occurring in the vicinity of Belhaven and Leechville. Moderate numbers of black bear still occur in the Leechville vicinity, and around and north of Pinetown. Ample populations of rabbits, bobwhite and dove occur throughout the county. Highest concentrations of doves occur in the picked corn fields during the December-January season. Moderate to high numbers of squirrel, raccoon, opossum, wildcat and foxes occur. Muskrat, raccoon, and mink are present in trappable numbers. The otter is present, but not abundant. Woodcock and snipe are common and a few rails are present. Waterfowl hunting is a major activity. High wood duck populations occur throughout the county, especially in the areas of timbered wetlands and small watercourses. There are relatively few Canada geese but excellent populations of both diving and tipping ducks occur on the Pamlico and Pungo rivers.

#### Fish

While licensed fishermen express a preference for catching largemouth bass, this species comprises only about two percent of the total catch. Bluegill and redbreast make up about 48 percent of the catch, with white perch, catfish and other panfish making up an additional 35 percent, shad, pickerel and crappie each comprise about three percent or less. Unlicensed fishermen indicate a high preference for bluegill and redbreast.

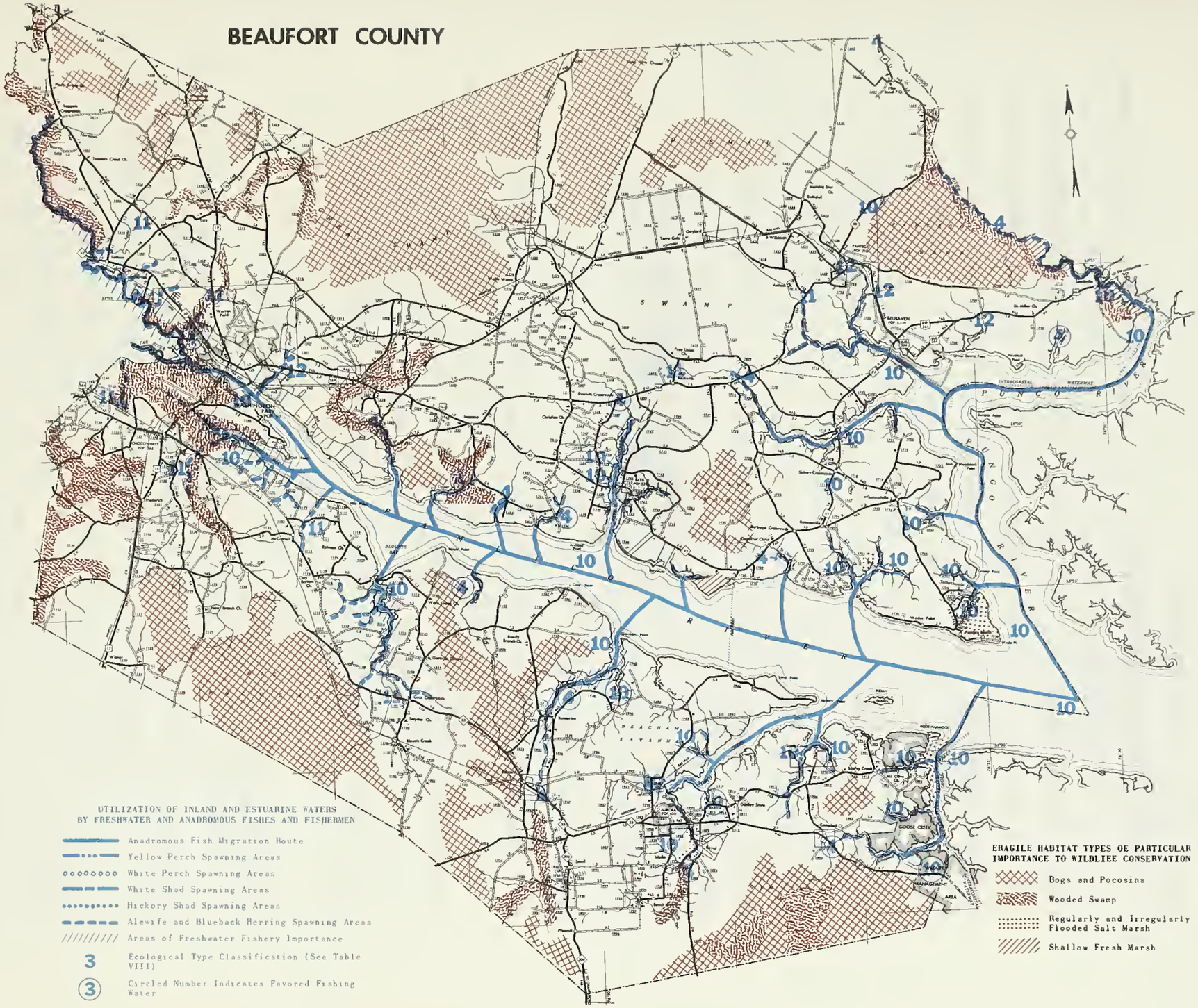
#### Rare and Endangered Species

Both the American alligator and the red-cockaded woodpecker are listed as endangered species in North Carolina, and both have recently recorded occurrence in Beaufort County. No recent sightings of the bald eagle or the peregrine falcon are known. The Atlantic sturgeon, which is considered to be rare, and the short-nosed sturgeon which is classed as endangered possibly occur in the Pamlico River.

## BEAUFORT COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 55,922 |
| Bear | 1,100 |
| Turkey | 0 |
| **Waterfowl** | |
| Ducks | 4,158 |
| Geese | 187 |
| **Other Game** | |
| Squirrel | 4,820 |
| Rabbit | 12,465 |
| Dove | 1,583 |
| Quail | 4,833 |
| Raccoon | 11,732 |
| Fox | 1,888 |
| Woodcock | 1,060 |
| Opossum | 6,480 |
| Wildcat | 360 |
| Clapper Rail | 0 |

# BEAUFORT COUNTY



## BERTIE COUNTY

### Wildlife

Deer are abundant throughout the county with very highest populations in the western half in association with the rich agricultural lands and the swampland sanctuary of the Roanoke floodplain. Only a remnant population of the black bear occurs along the Roanoke River north of Plymouth. The turkey population remains moderate to high in areas of better habitat in the Roanoke floodplain. Small game species, including quail, rabbit, squirrel, dove, woodcock, snipe, raccoon and opossum, are abundant throughout the county. Predator species such as the foxes occur in moderate numbers, however, the wildcat is scarce. Ducks occur in good numbers in the timbered wetlands and along the Roanoke and smaller watercourses. Most of these are wood duck, however mallards and black ducks also are common. Very few Canada geese are present. The major furbearers, mink, muskrat and otter, are present in good numbers and a moderate population of beaver occurs.

### Fish

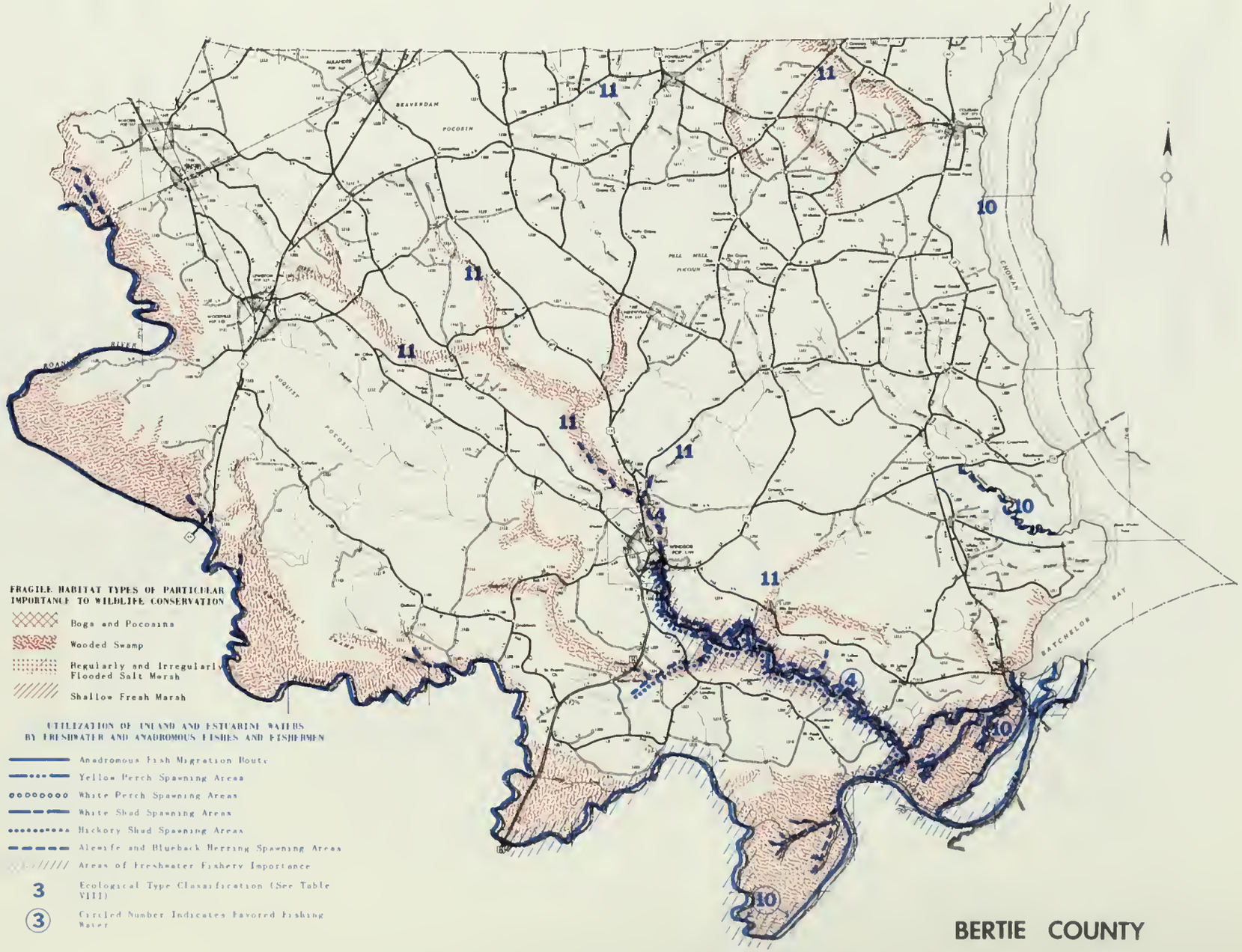
Bluegill, white perch, and other panfishes such as the warmouth and flier, comprise over 70 percent of the catch. Catfish, crappie and redbreast are next in fisherman-take. Largemouth bass, although it ranks first in preference as a game fish, comprises only about four percent of the catch, while striped bass makes up only about three percent.

### Rare and Endangered Species

Records as late as 1971 indicate the presence of the red-cockaded woodpecker in association with remnant longleaf and mature loblolly pines. The osprey still occurs in small numbers, however, there are no recent records of the endangered bald eagle or peregrine falcon. Sturgeon have been taken in the Roanoke River and the endangered short-nose sturgeon has been recently reported in Albemarle Sound. The endangered bigeye jumprock and the riverweed darter are listed in the Roanoke drainage, as well as the Carolina darter and Roanoke hogsucker.

## BERTIE COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 61,740 |
| Bear | 200 |
| Turkey | 237 |
| **Waterfowl** | |
| Ducks | 1,232 |
| Geese | 825 |
| **Other Game** | |
| Squirrel | 3,520 |
| Rabbit | 5,362 |
| Dove | 1,360 |
| Quail | 3,320 |
| Raccoon | 10,156 |
| Fox | 970 |
| Woodcock | 1,163 |
| Opossum | 3,650 |
| Wildcat | 200 |
| Clapper Rail | 0 |




BERTIE COUNTY

## BRUNSWICK COUNTY

### Wildlife

An ample deer population occurs throughout the county and an unusually large portion of the county is occupied black bear range. Generally, bears occur in most of that portion north and west of U. S. Highway 17. Wild turkeys occur, but in limited numbers, and only in those few locations which afford maximum sanctuary or are subject to limited hunting. Ample small game populations throughout the county include quail, rabbit, squirrel, woodcock, snipe, raccoon and opossum. The dove, however, is not as abundant as in most Coastal Plain counties. The clapper rail is very abundant in the tidal marshes in the Southport and Shallotte vicinities. Foxes and the wildcat are common. Raccoon is the most abundant furbearer and the otter is relatively common. However, mink, muskrat and beaver are uncommon to few in numbers. Wood ducks, which comprise about half of the moderate waterfowl population, are scattered throughout the wooded wetlands of the county. A mixture of other tipping and diving ducks are generally found in association with the Cape Fear River marshlands and ponds. A few Canada geese are present.

### Fish

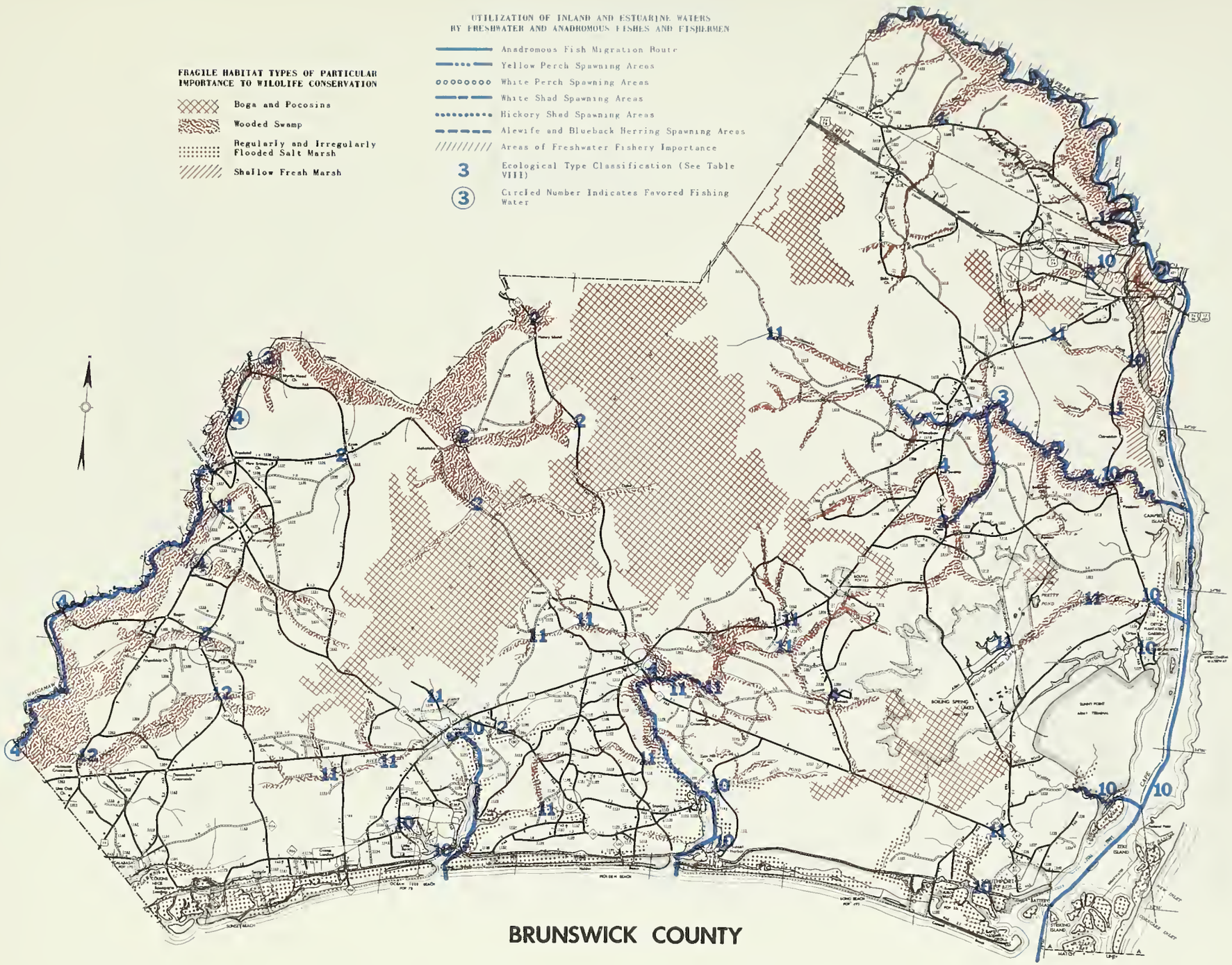
Redbreast, bluegill and other panfish (yellow perch, warmouth and flier) make up over 65 percent of the catch of freshwater fishes. Catfish, pickerel and crappie comprise an additional 28 percent, while the largemouth bass makes up a minor 3.2 percent. By preference, licensed and unlicensed residents express a choice for redbreast and bluegill, while nonresident anglers vote first for the largemouth bass.

### Rare and Endangered Species

The American alligator and the red-cockaded woodpecker are present and the loggerhead turtle is known to deposit its eggs on the sandy ocean shores of Baldhead Island. The osprey appears to be increasing. No recent records of the peregrine falcon are known; however, one bald eagle was reported seen near Boiling Spring Lakes in December 1972 and a nesting eagle was reported near Southport in July 1972. The Atlantic sturgeon occurs in the Cape Fear vicinity.

## BRUNSWICK COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 46,160 |
| Bear | 700 |
| Turkey | 32 |
| **Waterfowl** | |
| Ducks | 616 |
| Geese | 374 |
| **Other Game** | |
| Squirrel | 4,567 |
| Rabbit | 9,268 |
| Dove | 823 |
| Quail | 4,413 |
| Raccoon | 11,308 |
| Fox | 2,159 |
| Woodcock | 1,006 |
| Opossum | 3,646 |
| Wildcat | 368 |
| Clapper Rail | 300 |




BRUNSWICK COUNTY

## CAMDEN COUNTY

### Wildlife

A moderately high deer population occurs throughout the county with very high densities in the northeastern quarter. Limited numbers of black bear are present near Old Trap and east of South Mills. Bear hunting is prohibited by law. Ample small game populations exist, including rabbits, bobwhite, dove, woodcock, snipe, raccoon and opossum. The squirrel is not an abundant small game species. Hunting pressure for small game species is relatively light. Foxes are common, however, the wildcat is an uncommon species. Mink, raccoon, otter, and muskrat are the primary furbearing species and all occur in good numbers. The wood duck is the primary waterfowl species and a small number of Canada geese are present.

### Fish

Bluegill, white perch and other panfishes such as the warmouth and flier comprise over 70 percent of the catch. Catfish, crappie and redbreast are next in fisherman-take. Largemouth bass, although it ranks first in preference as a game fish, comprises only about four percent of the catch, while striped bass makes up only about three percent.

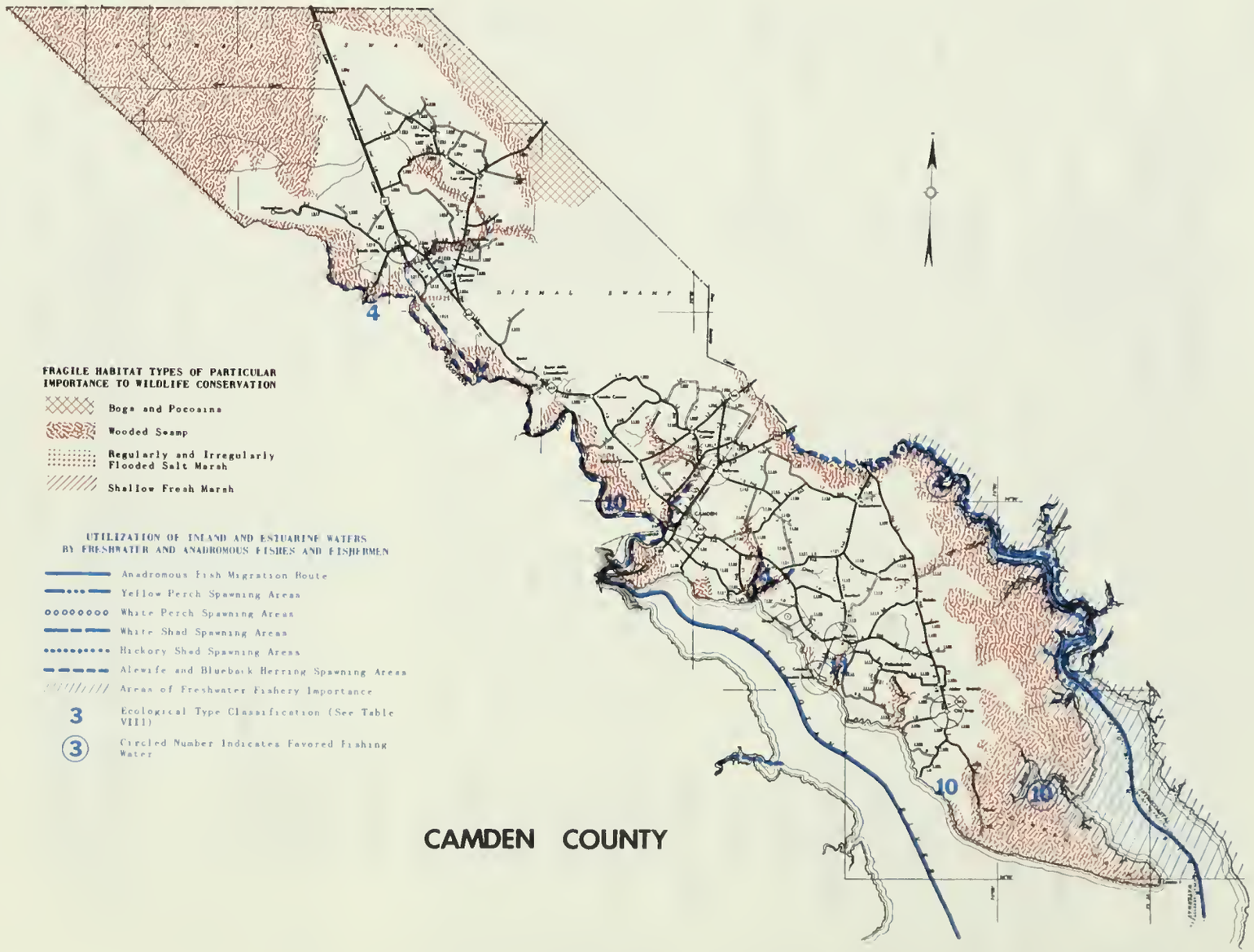
### Rare and Endangered Species

The bog and wooded swamp habitats which comprise the Great Dismal Swamp are occupied by three small mammals which are recognized as endangered species. These are the southeastern shrew, the swamp short-tailed shrew and the southern bog lemming. No recent reports of the bald eagle or peregrine falcon are known and the American alligator and red-cockaded woodpecker are not known to occur. The short-nose sturgeon could occur due to the proximity to Albemarle Sound.

## CAMDEN COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 20,085 |
| Bear | 200* |
| Turkey | 0 |
| **Waterfowl** | |
| Ducks | 262 |
| Geese | 550 |
| **Other Game** | |
| Squirrel | 823 |
| Rabbit | 3,226 |
| Dove | 460 |
| Quail | 2,090 |
| Raccoon | 5,072 |
| Fox | 259 |
| Woodcock | 703 |
| Opossum | 1,710 |
| Wildcat | 112 |
| Clapper Rail | 0 |

*Estimate of potential. Bear hunting currently prohibited by statute.




CAMDEN COUNTY

## CARTERET COUNTY

### Wildlife

Carteret has an abundant deer herd and a stable, moderate population of the black bear. A few wild turkeys occur. All three species of big game exist here in association with the large acreage of relatively "unroaded" woodlands. Small game species, including squirrel, rabbits, quail, woodcock, snipe, raccoon and opossum occur in moderate supply. However, the dove is not as abundant as in some other counties. Hunting pressure for small game is relatively light. The clapper rail is very abundant in the tidal coastal marshes, and a moderate amount of hunting for them is conducted in the marshes along Bogue Banks and in the vicinity of Morehead, Beaufort and Marshallburg. Foxes and the wildcat are common. The principal furbearers are raccoon and otter; mink are scarce; and the muskrat are found in limited number in association with inland ditches. Good populations of wood ducks occur in the inland wooded wetlands and good populations of diving ducks and other tipping ducks are found in Core Sound and in the waters of Pamlico Sound and the lower Neuse River. A moderate goose population occurs in the Hog Island vicinity.

### Fish

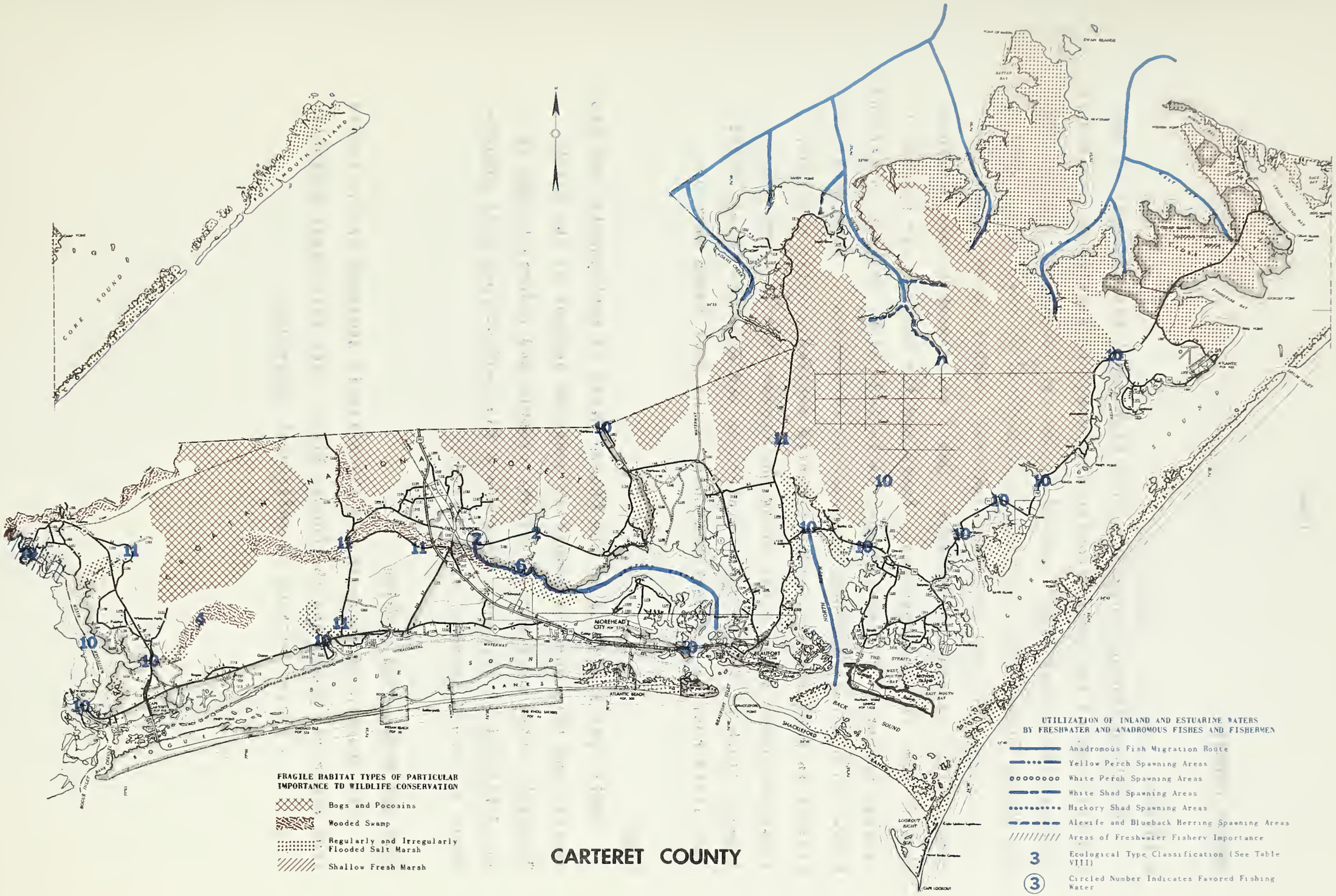
While licensed fishermen express a preference for catching largemouth bass, this species comprises only about two percent of the total catch. Bluegill and redbreast make up about 48 percent of the catch, with white perch, catfish and other panfishes making up an additional 35 percent; shad, pickerel and crappie each comprise about three percent or less. Unlicensed fishermen indicate a high preference for bluegill and redbreast.

### Rare and Endangered Species

The red-cockaded woodpecker, American alligator and brown pelican occur; the bald eagle and peregrine falcon possibly occur but no recent sightings have been recorded. The Carteret coast is within the presently recognized range of the Atlantic sturgeon.

## CARTERET COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 37,109 |
| Bear | 700 |
| Turkey | 32 |
| **Waterfowl** | |
| Ducks | 1,386 |
| Geese | 902 |
| **Other Game** | |
| Squirrel | 3,182 |
| Rabbit | 5,155 |
| Dove | 431 |
| Quail | 3,137 |
| Raccoon | 10,314 |
| Fox | 569 |
| Woodcock | 450 |
| Opossum | 2,616 |
| Wildcat | 240 |
| Clapper Rail | 486 |


CARTERET COUNTY
FRAGILE HABITAT TYPES OF PARTICULAR IMPORTANCE TO WILDLIFE CONSERVATION
Bogs and Pocosins
Wooded Swamp
Regularly and Irregularly Flooded Salt Marsh
Shallow Fresh Marsh
UTILIZATION OF INLAND AND ESTUARINE WATERS BY FRESHWATER AND ANADROMOUS FISHES AND FISHERMEN
Anadromous Fish Migration Route
Yellow Perch Spawning Areas
White Perch Spawning Areas
White Shad Spawning Areas
Hickory Shad Spawning Areas
Alewife and Blueback Herring Spawning Areas
Areas of Freshwater Fishery Importance
3 Ecological Type Classification (See Table VIII)
3 Circled Number Indicates Favored Fishing Water
CORE SOUND
OCRACOKE ISLAND
HOLLAND NATIONAL FOREST
MOREHEAD CITY
BEAUFORT
BOGUE SOUND
BANKS
BACK SOUND
SHACKLEFORD BANKS
NORTH RIVER
THE STRAITS
WEST MOUTH BAY
EAST MOUTH BAY
ATLANTIC BEACH
INTRACOASTAL WATERWAY
LOOKOUT BIGHT
CAPE LOOKOUT

## CHOWAN COUNTY

### Wildlife

Northern Chowan contains a very high population density of deer and the rest of the county contains an adequate population. A few individual bears have been reported at several locations, usually near the Chowan River. Bear hunting is prohibited by law. Small game species are abundant and include: squirrel, rabbit, dove, quail, woodcock, snipe, raccoon and opossum. Quail are somewhat more numerous than in some coastal counties. Foxes and the wildcat are present in average numbers. Furbearing species include mink, muskrat, otter and beaver in moderate numbers; the raccoon is abundant. Wood ducks are present in good numbers in the timbered wetlands; while mallards, scaup and other ducks occur along the Chowan, but in fewer numbers. A small flock of Canada geese winters on and near the Chowan River. Some field hunting for ducks is done in the Bear Swamp section.

### Fish

White perch fishing in the Chowan River is both popular and productive and this species comprises about 40 percent of the catch. Bluegill, other panfishes, catfish, crappie and redbreast make up an additional 53 percent. Largemouth bass and striped bass comprise about 3.5 and 3 percent, respectively.

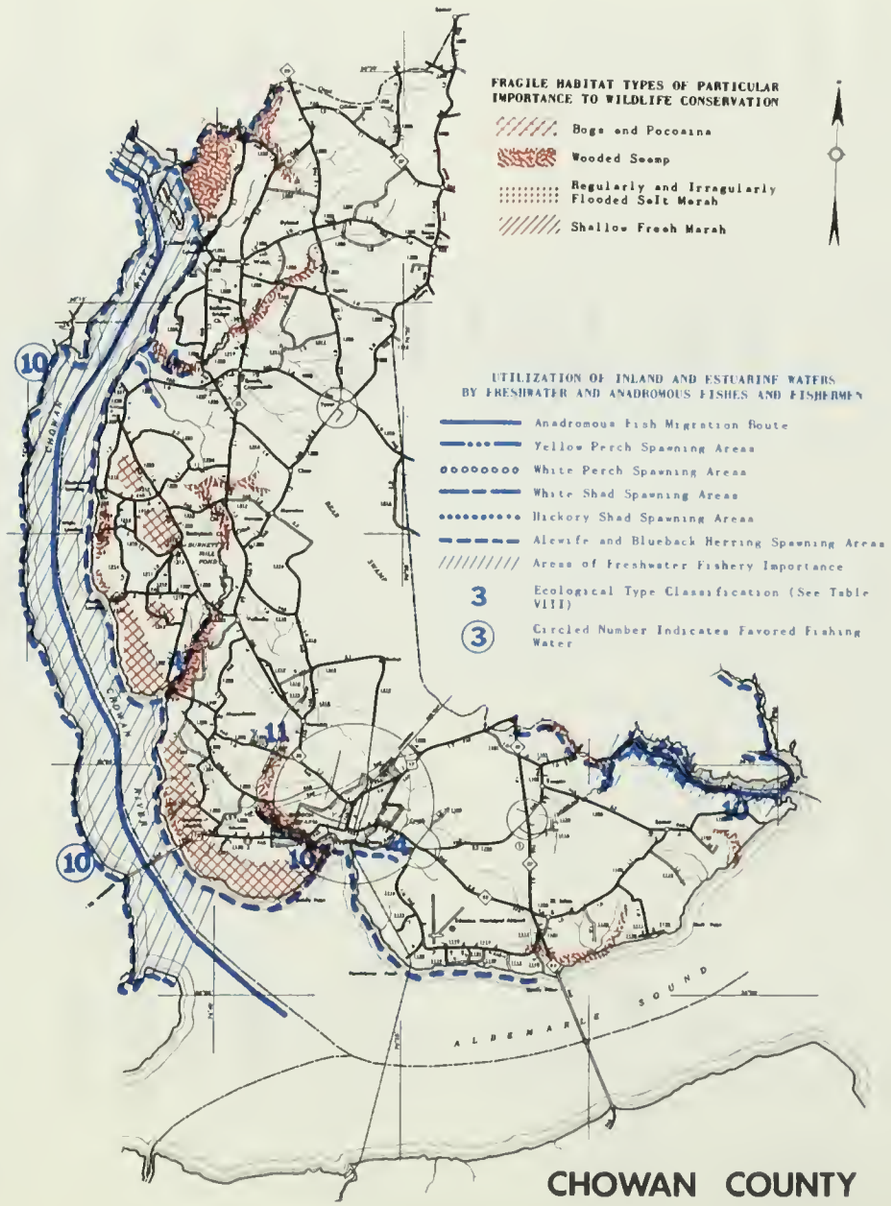
### Rare and Endangered Species

The short-nose sturgeon and the Atlantic sturgeon are on record from Albemarle Sound and the Chowan River. The bald eagle probably occurs as a winter visitor on infrequent occasions.

## CHOWAN COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **BIG GAME** | |
| Deer | 26,506 |
| Bear | 100* |
| Turkey | 0 |
| **Waterfowl** | |
| Ducks | 385 |
| Geese | 825 |
| **Other Game** | |
| Squirrel | 2,290 |
| Rabbit | 2,554 |
| Dove | 336 |
| Quail | 1,641 |
| Raccoon | 4,133 |
| Fox | 569 |
| Woodcock | 112 |
| Opossum | 1,404 |
| Wildcat | 80 |
| Clapper Rail | 0 |

*Estimate of potential. Bear hunting currently prohibited by statute.


FRAGILE HABITAT TYPES OF PARTICULAR IMPORTANCE TO WILDLIFE CONSERVATION
Bogs and Pocosins
Wooded Swamp
Regularly and Irregularly Flooded Salt Marsh
Shallow Fresh Marsh
UTILIZATION OF INLAND AND ESTUARINE WATERS BY FRESHWATER AND ANADROMOUS FISHES AND FISHERMEN
Anadromous Fish Migration Route
Yellow Perch Spawning Areas
White Perch Spawning Areas
White Shad Spawning Areas
Hickory Shad Spawning Areas
Alewife and Blueback Herring Spawning Areas
Areas of Freshwater Fishery Importance
3 Ecological Type Classification (See Table VIII)
3 Circled Number Indicates Favored Fishing Water
CHOWAN RIVER
ALBEMARLE SOUND
10
11
CHOWAN COUNTY

## CRAVEN COUNTY

### Wildlife

A moderately high deer population occurs throughout the county and a high density exists in the area along the Neuse River south of Vanceboro. A few bears occur in the southern portion of the county on the Croatan National Forest. Bear hunting is prohibited by county law. A moderate population of the wild turkey is present, primarily in the hardwood bottomlands along the Neuse River. Restocking has been undertaken on the Croatan National Forest, however, the success of this is undetermined at this time. A high quail population is found throughout the county and other small game species are abundant, including squirrel, rabbits, dove, woodcock, snipe, raccoon and opossum. Foxes and the wildcat occur in average densities. Good wood duck populations are present in the timbered wetlands and a moderate population of other species of ducks occur, especially along the Neuse River. A few Canada geese are present. Furbearers, including mink, otter, muskrat and beaver are found in average abundance.

### Fish

While licensed fishermen express a preference for catching largemouth bass, this species comprises only about two percent of the total catch. Bluegill and redbreast make up about 48 percent of the catch, with white perch, catfish and other panfishes making up an additional 35 percent; shad, pickerel and crappie each comprise about three percent or less. Unlicensed fishermen indicate a high preference for bluegill and redbreast.

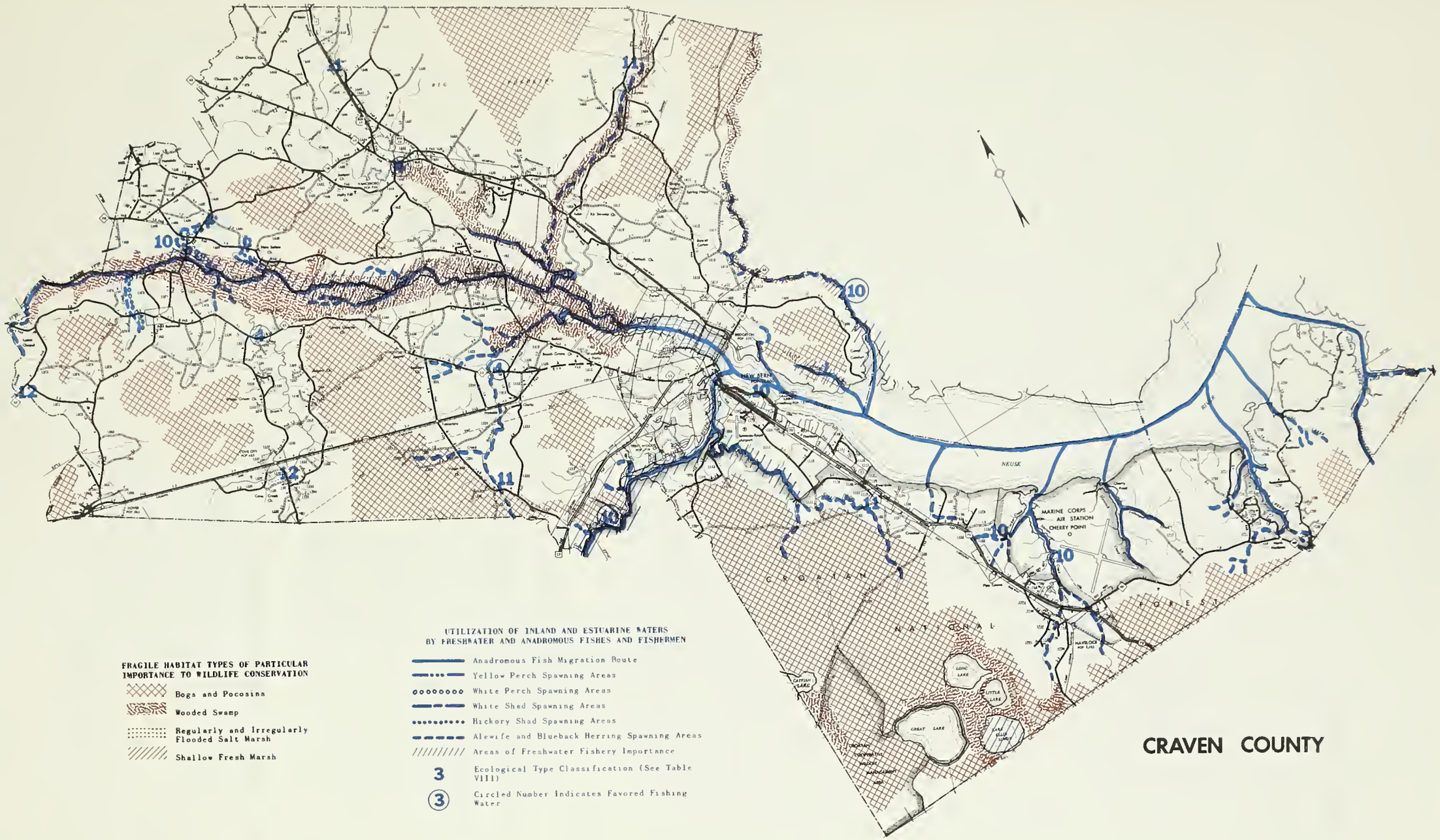
### Rare and Endangered Species

The red-cockaded woodpecker, American alligator and bald eagle, all endangered species, occur. One recent bald eagle report was at Cherry Point in March 1972. The rare Neuse River waterdog is reported for the Neuse and Tar river drainages. The Atlantic sturgeon probably occurs as a rare species in the Neuse drainage.

## CRAVEN COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 61,956 |
| Bear | 100* |
| Turkey | 79 |
| **Waterfowl** | |
| Ducks | 1,232 |
| Geese | 137 |
| **Other Game** | |
| Squirrel | 5,209 |
| Rabbit | 12,614 |
| Dove | 793 |
| Quail | 3,979 |
| Raccoon | 13,326 |
| Fox | 1,202 |
| Woodcock | 855 |
| Opossum | 4,498 |
| Wildcat | 272 |
| Clapper Rail | 0 |

*Estimate of potential. Bear hunting currently prohibited by statute.




**FRAGILE HABITAT TYPES OF PARTICULAR IMPORTANCE TO WILDLIFE CONSERVATION**

- Bogs and Pocosins
- Wooded Swamp
- Regularly and Irregularly Flooded Salt Marsh
- Shallow Fresh Marsh

**UTILIZATION OF INLAND AND ESTUARINE WATERS BY FRESHWATER AND ANADROMOUS FISHES AND FISHERMEN**

- Anadromous Fish Migration Route
- Yellow Perch Spawning Areas
- White Perch Spawning Areas
- White Shad Spawning Areas
- Hickory Shad Spawning Areas
- Alewife and Blueback Herring Spawning Areas
- Areas of Freshwater Fishery Importance
- 3 Ecological Type Classification (See Table VIII)
- (3) Circled Number Indicates Favored Fishing Water

# CRAVEN COUNTY

## CURRITUCK COUNTY

### Wildlife

A good deer herd occurs throughout most of the county and a high population exists in the northwestern third near Moyock. A few bears occur in the Moyock section, as well as in the swampy areas along the North River. (Bear hunting is prohibited by law.) Ample populations of all small game species include quail, rabbits, squirrel, woodcock, snipe, raccoon and opossum. Wildcat and foxes are present. Furbearers--mink, otter, muskrat and nutria--are present in ample numbers. Muskrat is the most important furbearer and each year several thousand pelts are taken from local marshes. The nutria, which was introduced into the county by local residents in the mid-1950's have increased to "nuisance" status. Waterfowl is the major wildlife resource. Recently, the duck population has averaged in excess of 50,000 and the Canada goose population about 15,000. Of aesthetic interest, whistling swans and greater snow geese are both common winter residents, with populations of both ranging in the thousands. Currituck has national recognition as a major waterfowl hunting area. Over 500 licensed hunting blinds are currently active in the Sound.

### Fish

The fresh to slightly brackish waters of Currituck Sound have received national recognition for largemouth bass fishing. Bluegill, other panfishes such as the warmouth and flier, and white perch comprise over 70 percent of the catch. Catfish, crappie and redbreast are next in fisherman-take. Largemouth bass, although it ranks first in preference as a game fish, comprises only about four percent of the catch, while striped bass makes up only about three percent.

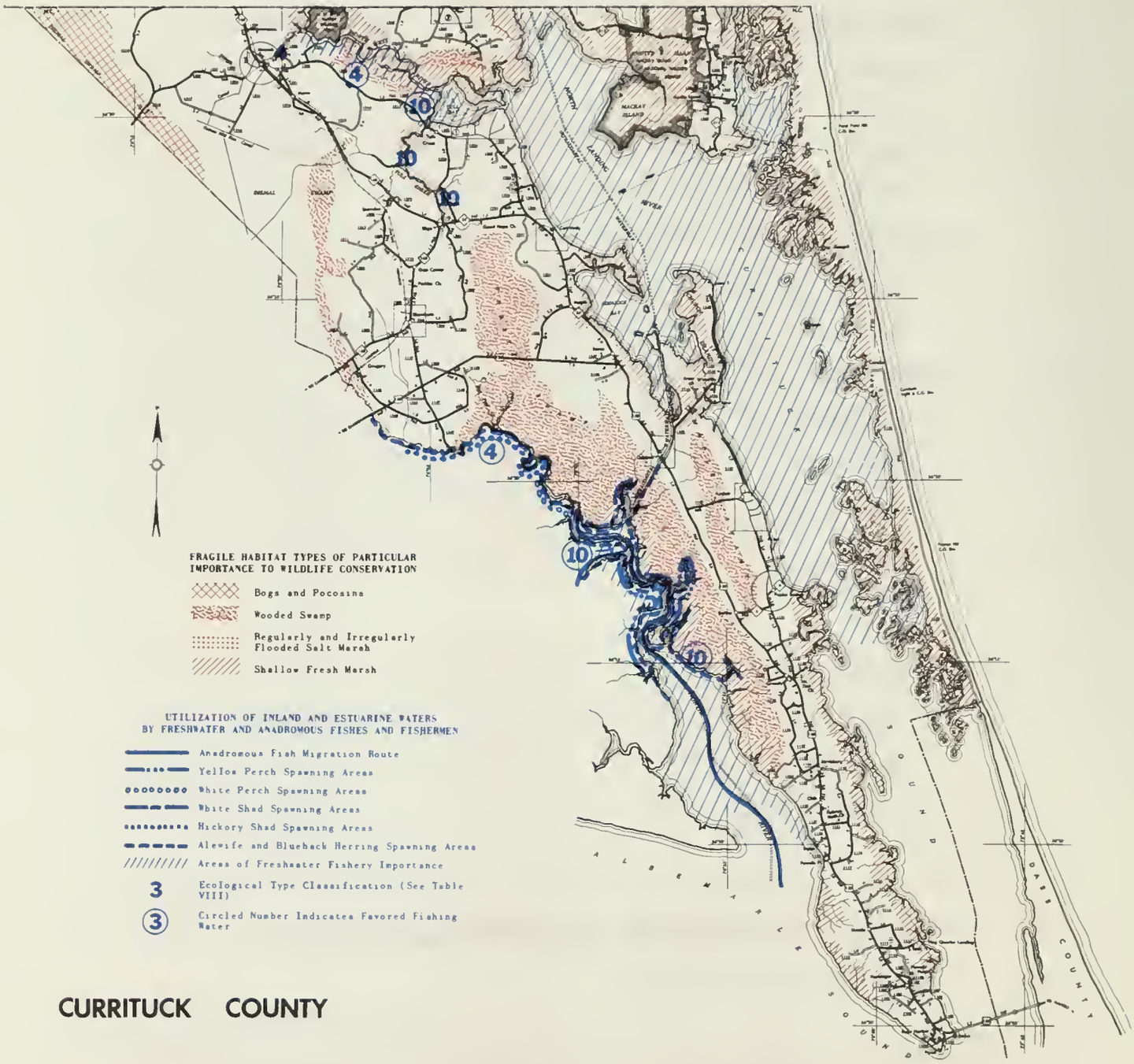
### Rare and Endangered Species

The bald eagle and peregrine falcon, both endangered species, have both been observed in Currituck County, primarily during the fall and winter months. The southeastern shrew, the swamp short-tailed shrew and the southern bog lemming probably occur in the Dismal Swamp portions of the county.

## CURRITUCK COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 15,300 |
| Bear | 200* |
| Turkey | 0 |
| **Waterfowl** | |
| Ducks | 7,962 |
| Geese | 16,500 |
| **Other Game** | |
| Squirrel | 1,068 |
| Rabbit | 3,004 |
| Dove | 412 |
| Quail | 1,096 |
| Raccoon | 3,781 |
| Fox | 233 |
| Woodcock | 480 |
| Opossum | 1,036 |
| Wildcat | 48 |
| Clapper Rail | 0 |

*Estimate of potential. Bear hunting currently prohibited by statute.




# CURRITUCK COUNTY

## DARE COUNTY

### Wildlife

Deer occur throughout the county in moderate numbers. Most of the county is considered to be occupied range for the black bear, however, fewer than 100 are thought to exist. Their numbers are considerably reduced from the population of two decades ago. Bear hunting is prohibited by law. All small game species occur; however, due to limited agricultural operations, populations of certain species are considered below average for the Coastal Plains area. Marsh rabbits, woodcock, raccoon and wildcat are plentiful; cottontail rabbits, opossum, foxes, snipe and rails occur in moderate numbers; quail, dove and squirrel are uncommon. Furbearers, including muskrat, mink, raccoon, otter and nutria, are in plentiful supply. Waterfowl, including most species which occur in the State, are present in ample numbers. The Pea Island National Wildlife Refuge, the coastal marshlands, and the shallow coastal waters of Currituck, Roanoke, Croatan and Pamlico sounds provide great diversity of habitat to support tipping, diving, and sea ducks; mergansers; Canada and greater snow geese; whistling swan and American brant.

### Fish

Bluegill, other panfishes such as the warmouth and flier, and white perch comprise over 70 percent of the catch. Catfish, crappie and redbreast are next in fisherman-take. Largemouth bass, although it ranks first in preference as a game fish, comprises only about four percent of the catch, while striped bass makes up only about three percent.

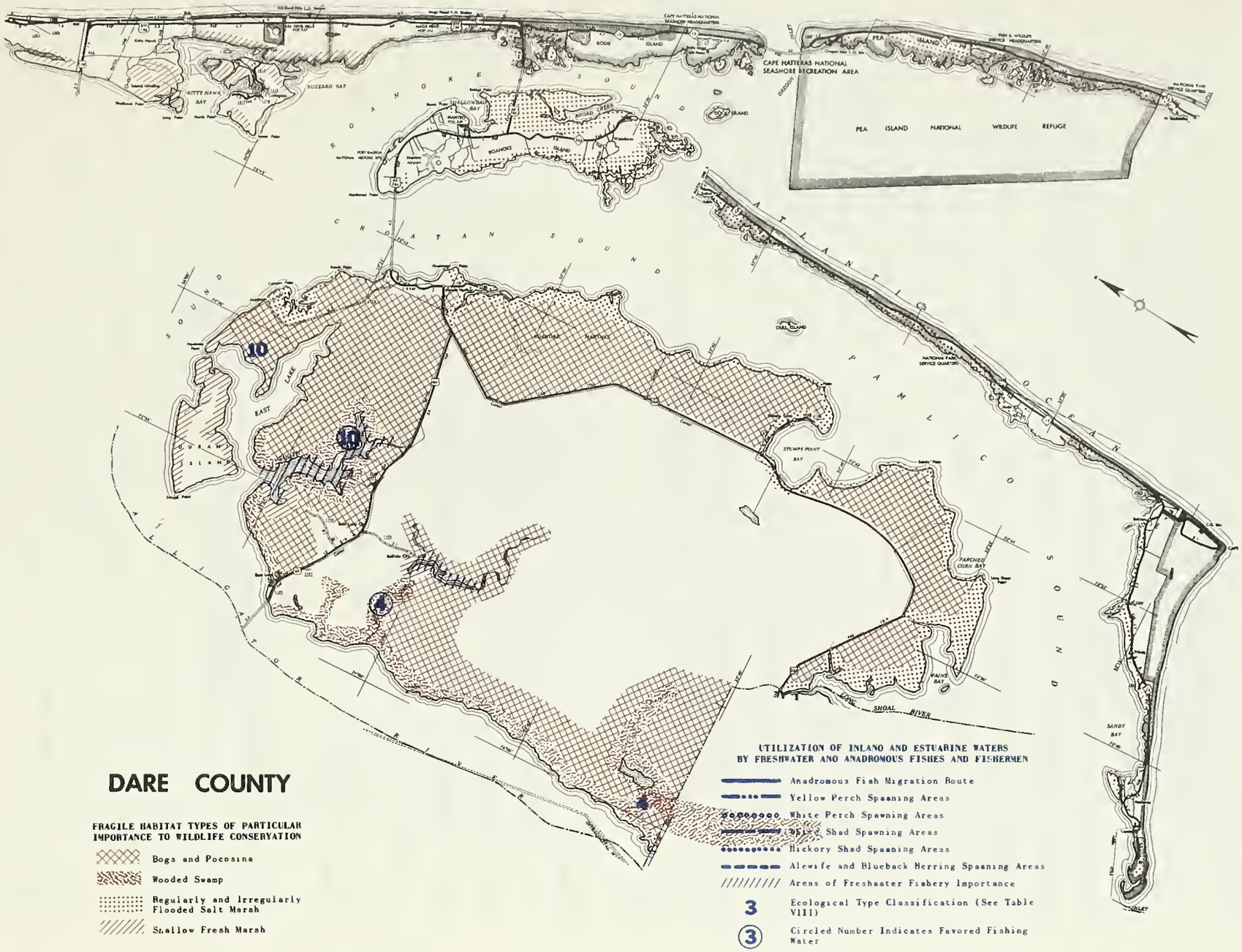
### Rare and Endangered Species

Endangered species which occur include the bald eagle, peregrine falcon and American alligator. The red-cockaded woodpecker and the Atlantic sturgeon could occur but current records do not substantiate this assumption. Similarly, more definite information is needed concerning occurrence and nesting of the loggerhead turtle which is known to occur in coastal waters in the Oregon Inlet area. The endangered Outer Banks king snake is reported to occur on Hatteras Island.

## DARE COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 15,408 |
| Bear | 1,100* |
| Turkey | 0 |
| **Waterfowl** | |
| Ducks | 3,311 |
| Geese | 5,500 |
| **Other Game** | |
| Squirrel | 1,388 |
| Rabbit | 1,800 |
| Dove | 124 |
| Quail | 1,212 |
| Raccoon | 9,654 |
| Fox | 284 |
| Woodcock | 951 |
| Opossum | 1,312 |
| Wildcat | 104 |
| Clapper Rail | 32 |

*Estimate of potential. Bear hunting currently prohibited by statute.




# DARE COUNTY

FRAGILE HABITAT TYPES OF PARTICULAR IMPORTANCE TO WILDLIFE CONSERVATION

- Bogs and Pocosins
- Wooded Swamp
- Regularly and Irregularly Flooded Salt Marsh
- Shallow Fresh Marsh

## GATES COUNTY

### Wildlife

Gates County has for many years had one of the highest deer densities in the State. It was the first county to have a season on antlerless deer and has in recent years (through the 1972-73 season) had an either-sex season for the entire length of the open deer season. A remnant population of black bear still exists in the swamps which occur along the Chowan River south of Gatesville; however, bear hunting is prohibited by law. Small game--quail, rabbits, squirrel, dove, woodcock, snipe, raccoon and opossum--exists in ample supply. Foxes and wildcat are present in moderate numbers. Furbearers including muskrat, mink, otter and beaver, occur in moderate numbers, and the raccoon is abundant. The predominant waterfowl species is the wood duck which occurs in ample numbers. A small number of other species, primarily mallards, occurs along the Chowan River and on and in the vicinity of Merchants Mill Pond. A few Canada geese occur primarily on the Chowan River.

### Fish

Bluegill, other panfishes such as the warmouth and flier, and white perch comprise over 70 percent of the catch. Catfish, crappie and redbreast are next in fisherman-take. Largemouth bass, although it ranks first in preference as a game fish, comprises only about four percent of the catch, while striped bass makes up only about three percent.

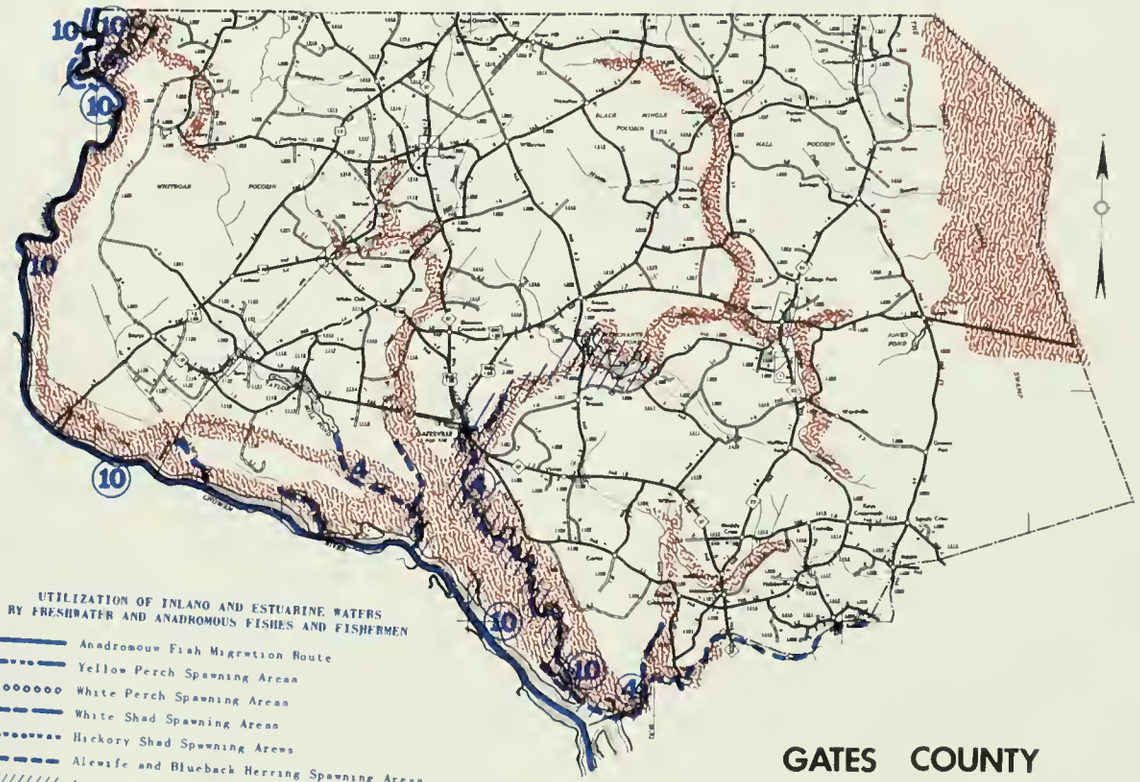
### Rare and Endangered Species

The red-cockaded woodpecker occurs in stands of mature loblolly pine. The southeastern shrew, swamp short-tailed shrew and southern hog lemming occur in the Dismal Swamp or eastern portion of the county. All of these are classified endangered species. The endangered short-nosed sturgeon and the Atlantic sturgeon probably occur in the Chowan River, however, occurrence records are scarce for these species.

## GATES COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 81,071 |
| Bear | 200* |
| Turkey | 0 |
| **Waterfowl** | |
| Ducks | 462 |
| Geese | 165 |
| **Other Game** | |
| Squirrel | 3,290 |
| Rabbit | 5,057 |
| Dove | 656 |
| Quail | 3,606 |
| Raccoon | 12,350 |
| Fox | 866 |
| Woodcock | 997 |
| Opossum | 5,400 |
| Wildcat | 232 |
| Clapper Rail | 0 |

*Estimate of potential. Bear hunting currently prohibited by statute.




UTILIZATION OF INLAND AND ESTUARINE WATERS BY FRESHWATER AND ANADROMOUS FISHES AND FISHERMEN

- Anadromous Fish Migration Route
- Yellow Perch Spawning Areas
- White Perch Spawning Areas
- White Shad Spawning Areas
- Hickory Shad Spawning Areas
- Alewife and Blueback Herring Spawning Areas
- Areas of Freshwater Fishery Importance
- 3 Ecological Type Classification (See Table VIII)
- (3) Circled Number Indicates Favored Fishing Water

# GATES COUNTY

FRAGILE HABITAT TYPES OF PARTICULAR IMPORTANCE TO WILDLIFE CONSERVATION

- Bogs and Pocosins
- Wooded Swamp
- Regularly and Irregularly Flooded Salt Marsh
- Shallow Fresh Marsh

## HERTFORD COUNTY

### Wildlife

An abundant deer herd exists throughout the county, with high populations occurring in the southwestern quarters. A remnant bear population still exists along the Chowan River in the vicinity of Harrellsville. Small game occur in abundance, including: quail, rabbits, squirrel, dove, woodcock, snipe, raccoon and opossum. Foxes are common; the wildcat uncommon. Furbearers, including the mink, muskrat, otter and beaver occur in ample numbers. The primary waterfowl species is the wood duck which occurs along the small watercourses and in the swamps and hardwood bottomlands. Mallards and a few other species are present, and are most commonly found on and near the Chowan River. A few Canada geese are present, primarily as a result of management and protection by a few individual landowners.

### Fish

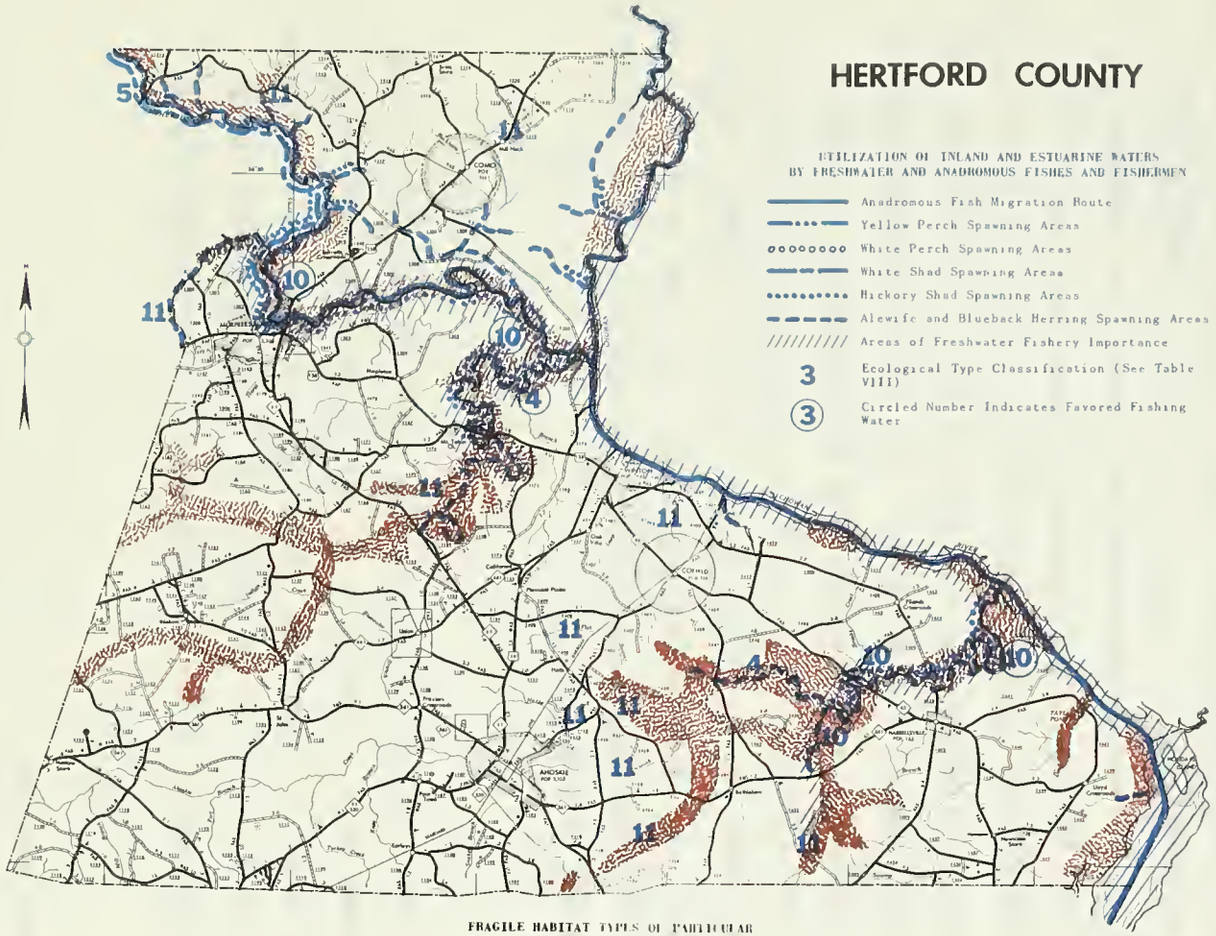
Bluegill, other panfishes such as the warmouth and flier, and white perch comprise over 70 percent of the catch. Catfish, crappie and redbreast are next in fisherman-take. Largemouth bass, although it ranks first in preference as a game fish, comprises only about four percent of the catch, while striped bass makes up only about three percent.

### Rare and Endangered Species

The red-cockaded woodpecker and the short-nose Atlantic sturgeon are thought to be the only endangered species which occur.

## HERTFORD COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 37,432 |
| Bear | 100 |
| Turkey | 0 |
| **Waterfowl** | |
| Ducks | 924 |
| Geese | 165 |
| **Other Game** | |
| Squirrel | 2,342 |
| Rabbit | 4,683 |
| Dove | 668 |
| Quail | 2,012 |
| Raccoon | 4,709 |
| Fox | 375 |
| Woodcock | 417 |
| Opossum | 1,792 |
| Wildcat | 144 |
| Clapper Rail | 0 |


HERTFORD COUNTY
UTILIZATION OF INLAND AND ESTUARINE WATERS BY FRESHWATER AND ANADROMOUS FISHES AND FISHERMEN
Anadromous Fish Migration Route
Yellow Perch Spawning Areas
White Perch Spawning Areas
White Shad Spawning Areas
Hickory Shad Spawning Areas
Alewife and Blueback Herring Spawning Areas
Areas of Freshwater Fishery Importance
3 Ecological Type Classification (See Table VIII)
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FRAGILE HABITAT TYPES OF PARTICULAR IMPORTANCE TO WILDLIFE CONSERVATION
Bogs and Pocosins
Wooded Swamp
Regularly and Irregularly Flooded Salt Marsh
Shallow Fresh Marsh

## HYDE COUNTY

### Wildlife

A high deer population occurs over most of the county and a relatively high black bear population is present in the vast tracts of woodland. Small game populations are also high including quail, squirrel, rabbits, dove, woodcock, snipe, raccoon and opossum. Rails occur in the coastal marshes, but are seldom hunted. Foxes and wildcat are common. Furbearers, including mink, raccoon, muskrat and otter, occur in abundance. Hyde County and Lake Mattamuskeet have national recognition for excellence in hunting for the Canada goose and for most all species of waterfowl common to the State. In recent years, however, the population of geese has decreased from over 100,000 to about 25,000, primarily as a result of a shift to wintering grounds in the rich agricultural areas of the Delmarva Peninsula. The duck population for the county has experienced a gradual increase in recent years, and is currently the highest of any county in the State, estimated in 1975 at approximately 135,000 birds.

### Fish

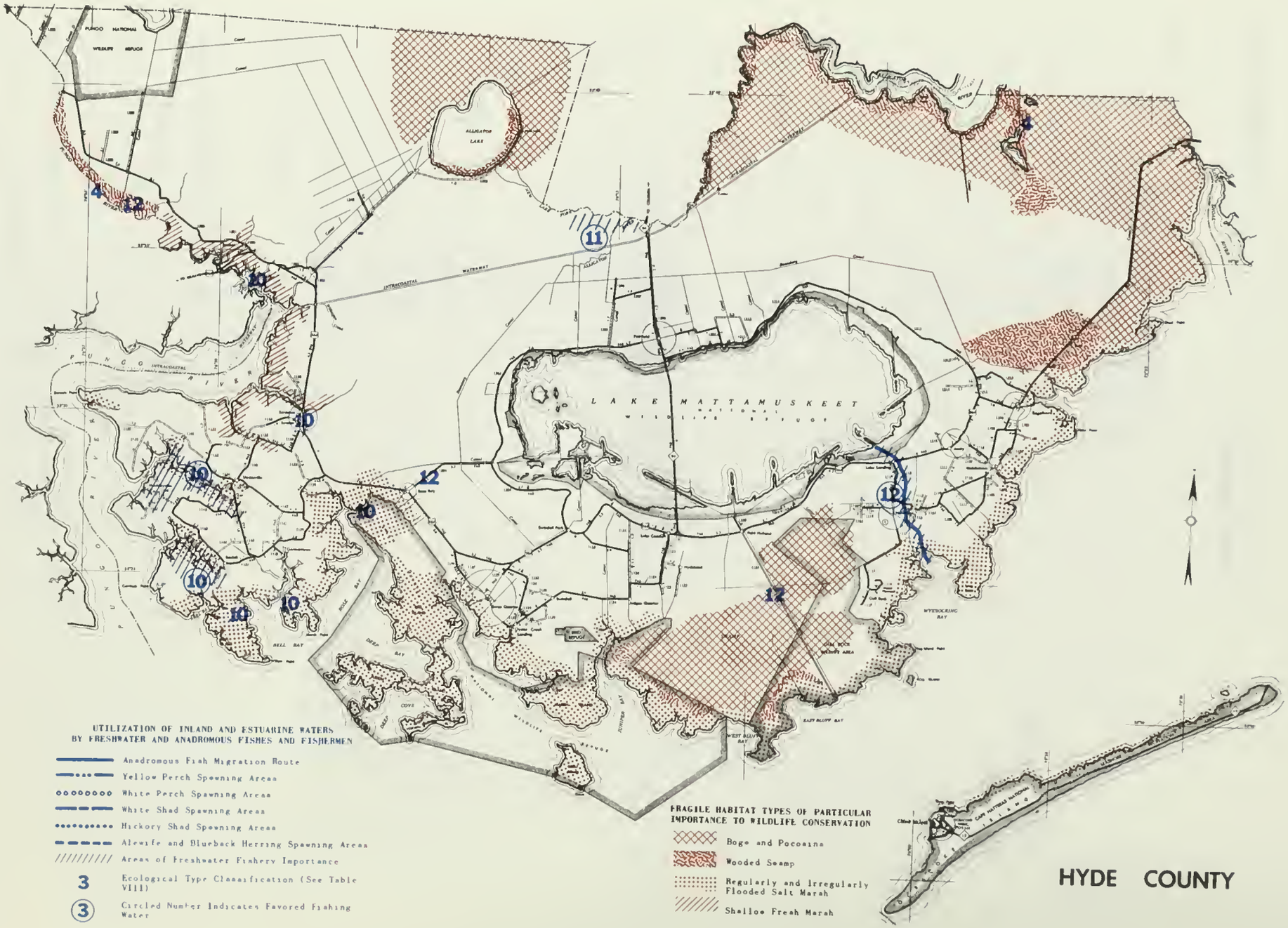
Bluegill, other panfishes such as the warmouth and flier, and white perch comprise over 70 percent of the catch. Catfish, crappie and redbreast are next in fisherman-take. Largemouth bass, although it ranks first in preference as a game fish, comprises only about four percent of the catch, while striped bass makes up only about three percent.

### Rare and Endangered Species

Endangered species include the brown pelican which is reported to nest in the vicinity of Ocracoke Inlet, and the bald eagle, peregrine falcon, American alligator, red-cockaded woodpecker and loggerhead turtle. The status of occurrence of the Atlantic sturgeon is unknown. The endangered Outer Banks king snake is reported to occur on Ocracoke Island.

## HYDE COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 64,865 |
| Bear | 1,100 |
| Turkey | 0 |
| **Waterfowl** | |
| Ducks | 20,790 |
| Geese | 22,000 |
| **Other Game** | |
| Squirrel | 1,091 |
| Rabbit | 10,060 |
| Dove | 1,008 |
| Quail | 5,803 |
| Raccoon | 15,477 |
| Fox | 621 |
| Woodcock | 1,099 |
| Opossum | 5,108 |
| Wildcat | 696 |
| Clapper Rail | 63 |


PUNGO NATIONAL WILDLIFE REFUGE
ALLIGATOR LAKE
ALLIGATOR RIVER
INTRACOASTAL WATERWAY
PUNGO RIVER
LAKE MATTAMUSKEET NATIONAL WILDLIFE REFUGE
WYSOKING BAY
EAST BULLPEN BAY
WEST BULLPEN BAY
BELL BAY
POLE BAY
DEEP BAY
DEEP COVE
NATIONAL WILDLIFE REFUGE
SWANNER BAY
CAPE HATTERAS NATIONAL SEASHORE
4
12
10
11
17
UTILIZATION OF INLAND AND ESTUARINE WATERS BY FRESHWATER AND ANADROMOUS FISHES AND FISHERMEN
Anadromous Fish Migration Route
Yellow Perch Spawning Areas
White Perch Spawning Areas
White Shad Spawning Areas
Hickory Shad Spawning Areas
Alewife and Blueback Herring Spawning Areas
Areas of Freshwater Fishery Importance
3 Ecological Type Classification (See Table VIII)
3 Circled Number Indicates Favored Fishing Water
FRAGILE HABITAT TYPES OF PARTICULAR IMPORTANCE TO WILDLIFE CONSERVATION
Bogs and Pocosins
Wooded Swamp
Regularly and Irregularly Flooded Salt Marsh
Shallow Fresh Marsh

# HYDE COUNTY

## NEW HANOVER COUNTY

### Wildlife

Unlike most Coastal Plain counties which have deer generally distributed over the entire county, the New Hanover deer are located only in that part of the county above an east-west line located a few miles north of Wilmington. They are fairly abundant and in some years cause agricultural depredation in the Castle Hayne section. A remnant population, consisting of only a few black bears exists in the extreme northwestern part of the county along the Northeast Cape Fear River. A few turkeys also occur in this area. A moderately small game population exists throughout the county, including quail, squirrel, rabbits, dove, woodcock, snipe, raccoon and opossum. Raccoon and otter are the principal furbearers; muskrat and mink occur in limited numbers. Foxes and wildcat are present in limited numbers. Clapper rail, which occupies the tidal marshes, provides limited hunting. A moderate population of ducks, primarily wood ducks, occurs on the wooded watercourses and in the inland marshes; a limited number of other species of ducks occur along the Cape Fear and coastal marshes. A few Canada geese are present.

### Fish

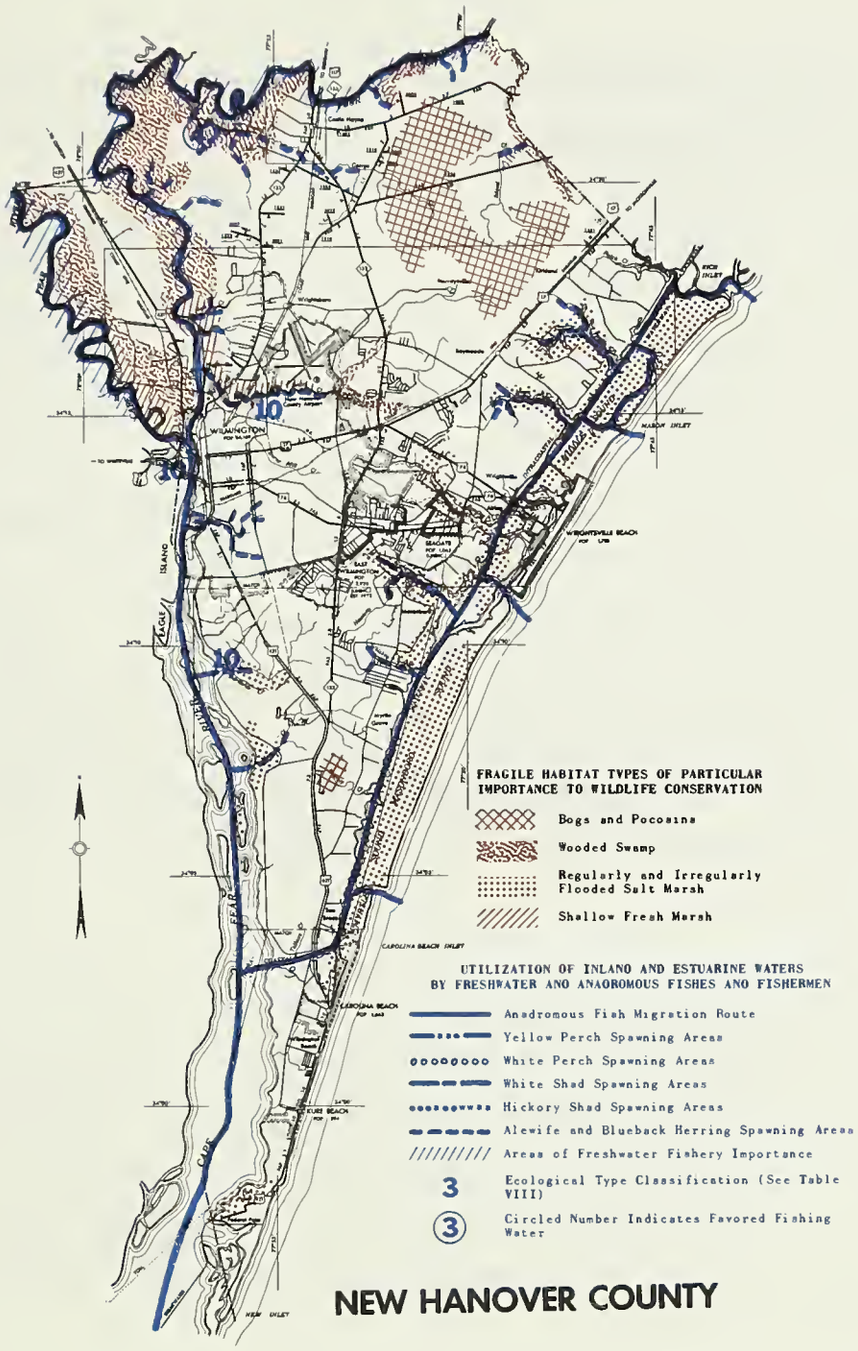
While licensed fishermen express a preference for catching largemouth bass, this species comprises only about two percent of the total catch. Bluegill and redbreast make up about 48 percent of the catch, with white perch, catfish and other panfishes making up an additional 35 percent; shad, pickerel and crappie each comprise about three percent or less. Unlicensed fishermen indicate a high preference for bluegill and redbreast.

### Rare and Endangered Species

The American alligator, red-cockaded woodpecker, Atlantic sturgeon and loggerhead turtle are endangered species which occur in the county. The bald eagle is reported in immediately adjacent Brunswick County, so occurrence is possible in New Hanover.

## NEW HANOVER COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 7,973 |
| Bear | 100 |
| Turkey | 16 |
| **Waterfowl** | |
| Ducks | 231 |
| Geese | 66 |
| **Other Game** | |
| Squirrel | 1,642 |
| Rabbit | 1,460 |
| Dove | 214 |
| Quail | 1,101 |
| Raccoon | 3,121 |
| Fox | 465 |
| Woodcock | 115 |
| Opossum | 1,022 |
| Wildcat | 80 |
| Clapper Rail | 131 |


FRAGILE HABITAT TYPES OF PARTICULAR IMPORTANCE TO WILDLIFE CONSERVATION
Bogs and Pocosins
Wooded Swamp
Regularly and Irregularly Flooded Salt Marsh
Shallow Fresh Marsh
UTILIZATION OF INLAND AND ESTUARINE WATERS BY FRESHWATER AND ANADROMOUS FISHES AND FISHERMEN
Anadromous Fish Migration Route
Yellow Perch Spawning Areas
White Perch Spawning Areas
White Shad Spawning Areas
Hickory Shad Spawning Areas
Alewife and Blueback Herring Spawning Areas
Areas of Freshwater Fishery Importance
3 Ecological Type Classification (See Table VIII)
3 Circled Number Indicates Favored Fishing Water
NEW HANOVER COUNTY

## ONSLOW COUNTY

### Wildlife

Deer occur throughout the county in moderate numbers, with high densities in the New River vicinity and on the Camp Lejeune Marine Base. Bears are still present and a few occur in the heavily wooded areas of Camp Lejeune and in the vicinities of Belgrade and Dixon. An excellent population of wild turkeys has been maintained through habitat development and protection on Camp Lejeune and a few scattered flocks exist in other remote sections of the county. Small game populations, including quail, squirrel, rabbits, woodcock, snipe and opossum, occur in moderate numbers, however, dove and raccoon populations are somewhat below the average abundance for other coastal counties except a moderate raccoon population does occur on Camp Lejeune. Clapper rails are common in the coastal tidal marshes. Foxes and the wildcat are present in average to above average numbers. Furbearers include raccoon, mink, otter and muskrat, however, the muskrat is uncommon except in the inland marshes and watercourses.

### Fish

While licensed fishermen express a preference for catching largemouth bass, this species comprises only about two percent of the total catch. Bluegill and redbreast make up about 48 percent of the catch, with white perch, catfish and other panfishes making up an additional 35 percent; shad, pickerel and crappie each comprise about three percent or less. Unlicensed fishermen indicate a high preference for bluegill and redbreast.

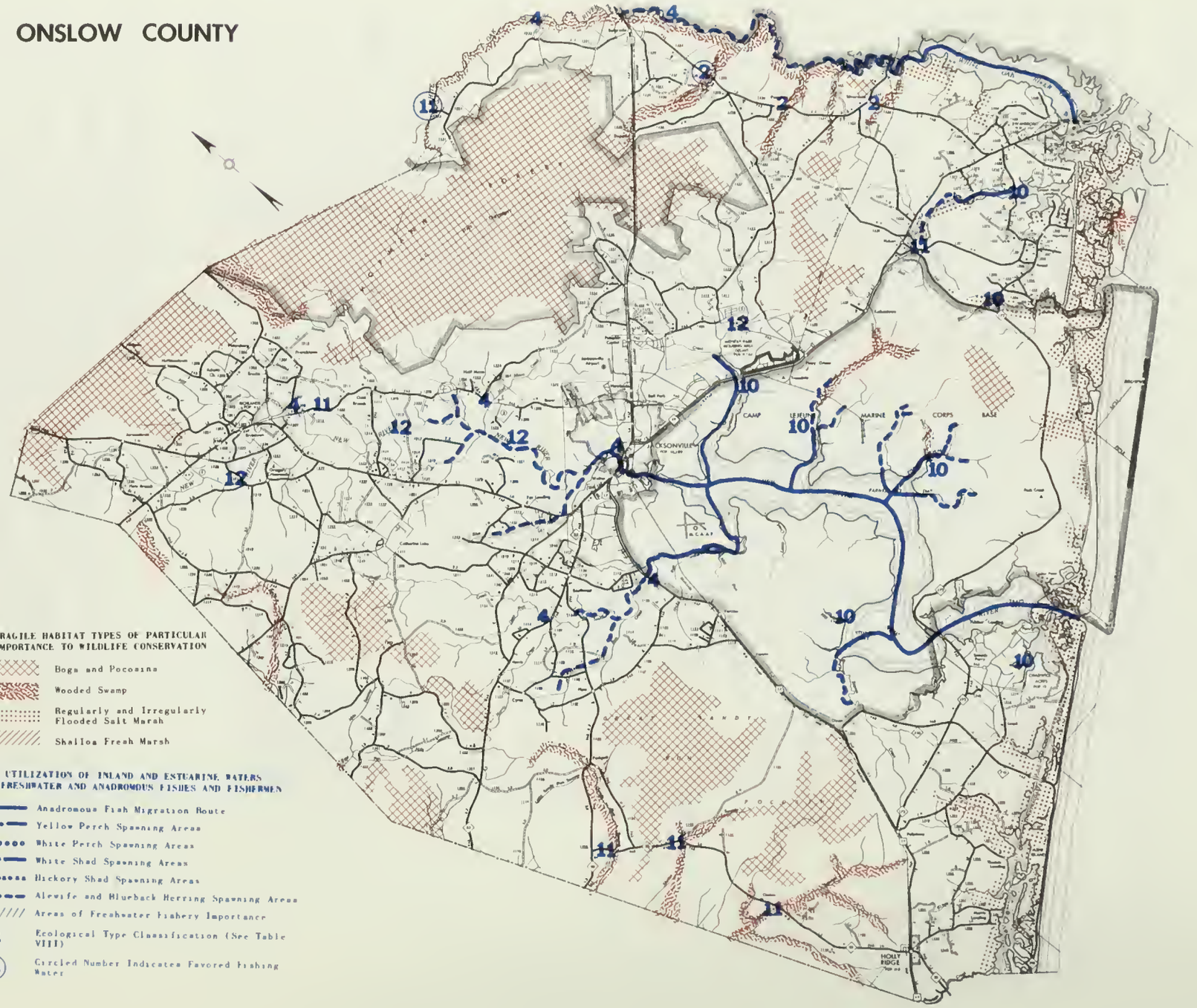
### Rare and Endangered Species

The bald eagle, American alligator and red-cockaded woodpecker are existing endangered species, as is the loggerhead turtle. The Atlantic sturgeon possibly occurs in the New River estuary, however, no records are available.

## ONSLOW COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 28,274 |
| Bear | 400 |
| Turkey | 158 |
| **Waterfowl** | |
| Ducks | 1,186 |
| Geese | 77 |
| **Other Game** | |
| Squirrel | 4,156 |
| Rabbit | 9,530 |
| Dove | 817 |
| Quail | 3,145 |
| Raccoon | 8,920 |
| Fox | 1,655 |
| Woodcock | 818 |
| Opossum | 3,854 |
| Wildcat | 288 |
| Clapper Rail | 206 |

# ONSLOW COUNTY



## PAMLICO COUNTY

### Wildlife

A high deer population occurs throughout most of the county and a moderate bear population occurs along the northern county line from Messic to Hobucken. Most all small game species occur in abundance, including quail, rabbits, squirrel, dove, woodcock, snipe, raccoon and opossum. Foxes and wildcat are common. The clapper rail occurs in the coastal marshes, however, it is hunted infrequently. Abundant populations of all furbearers are present, including mink, otter, muskrat, beaver and nutria. Pamlico has an excellent waterfowl population. Wood ducks are abundant inland, and a wide variety of other tipping ducks and diving ducks occur in the Neuse and Pamlico rivers, Pamlico Sound and in the natural and managed coastal marshlands and impoundments. Several thousand acres of mosquito control impoundments are currently being managed by the Wildlife Resources Commission and private interest. These areas of improved waterfowl habitat have done a great deal toward increasing both the numbers and variety of waterfowl which winter and also nest in this area. A small number of Canada geese occurs.

### Fish

While licensed fishermen express a preference for catching largemouth bass, this species comprises only about two percent of the total catch. Bluegill and redbreast make up about 48 percent of the catch, with white perch, catfish and other panfishes making up an additional 35 percent, shad, pickerel and crappie each comprise about three percent or less. Unlicensed fishermen indicate a high preference for bluegill and redbreast.

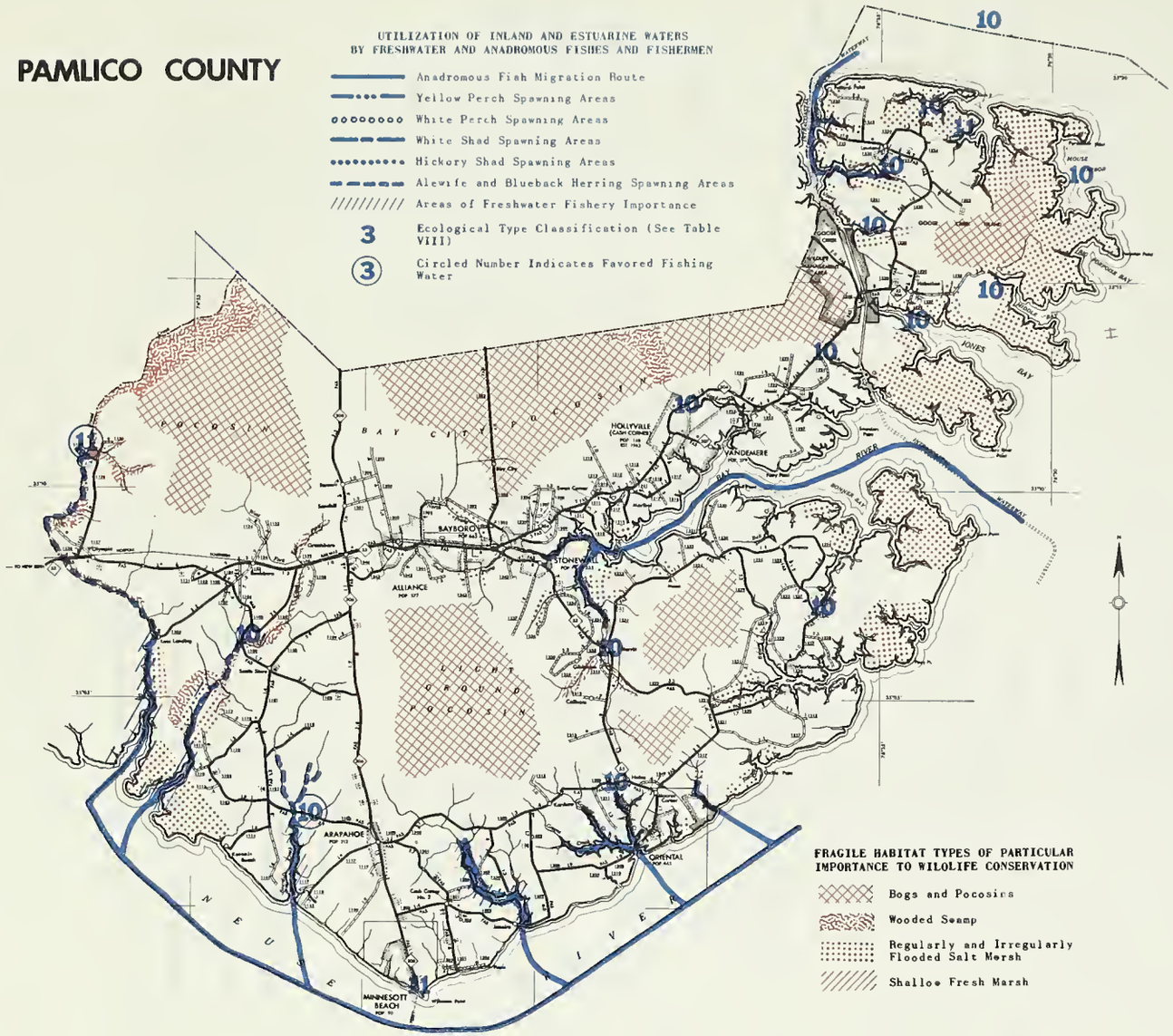
### Rare and Endangered Species

The American alligator is known to occur; the bald eagle and Atlantic sturgeon may be present.

## PAMLICO COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 21,873 |
| Bear | 700 |
| Turkey | 0 |
| **Waterfowl** | |
| Ducks | 1,802 |
| Geese | 407 |
| **Other Game** | |
| Squirrel | 3,266 |
| Rabbit | 7,476 |
| Dove | 600 |
| Quail | 2,950 |
| Raccoon | 8,320 |
| Fox | 1,008 |
| Woodcock | 547 |
| Opossum | 2,946 |
| Wildcat | 152 |
| Clapper Rail | 30 |

# PAMLICO COUNTY



## PASQUOTANK COUNTY

### Wildlife

A moderate deer herd occurs throughout most of the county. A few bears are still present in the Great Dismal Swamp northwest of Elizabeth City, however, hunting for bear is presently prohibited by statute. Small game species occur in ample numbers including quail, rabbits, squirrel, dove, woodcock, snipe, raccoon and opossum. Foxes are common; wildcat is uncommon. Furbearing species including raccoon, muskrat, mink and otter, occur in ample numbers. Waterfowl are not abundant in the county, however, the wood duck is present along the timbered watercourses and small numbers of mallards and black ducks occur. A small flock of Canada geese rest on Albemarle Sound. Some field and swamp hunting for them is done.

### Fish

Bluegill, other panfishes such as the warmouth and flier, and white perch comprise over 70 percent of the catch. Catfish, crappie and redbreast are next in fisherman-take. Largemouth bass, although it ranks first in preference as a game fish, comprises only about four percent of the catch, while striped bass makes up only about three percent.

### Rare and Endangered Species

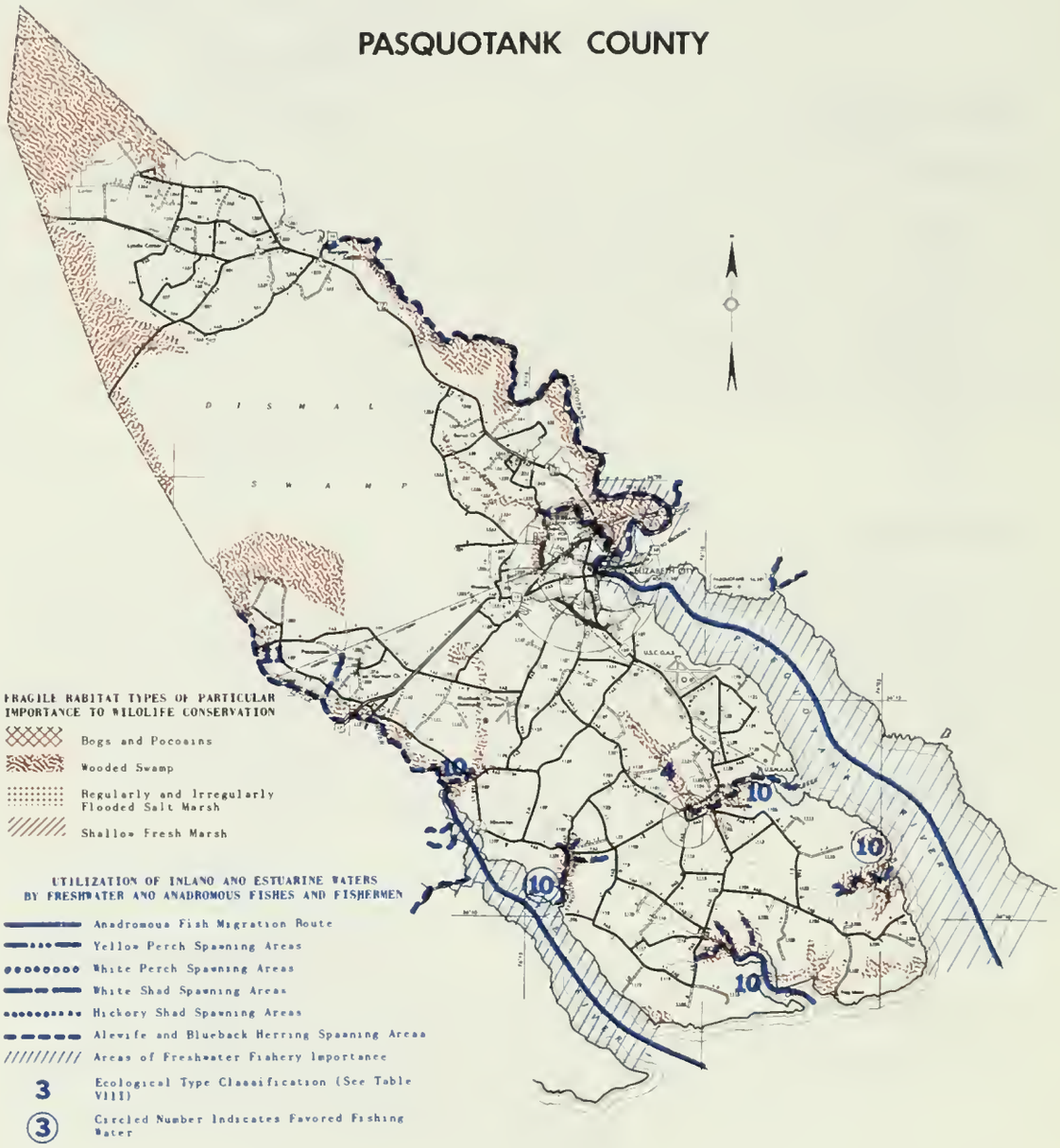
The southeastern shrew, swamp short-tailed shrew and bog lemming are endangered mammals reported to occur here; the short-nose and Atlantic sturgeons are endangered fish which probably occur.

## PASQUOTANK COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 20,839 |
| Bear | 100* |
| Turkey | 0 |
| **Waterfowl** | |
| Ducks | 339 |
| Geese | 550 |
| **Other Game** | |
| Squirrel | 1,412 |
| Rabbit | 3,240 |
| Dove | 426 |
| Quail | 2,807 |
| Raccoon | 6,866 |
| Fox | 556 |
| Woodcock | 417 |
| Opossum | 2,304 |
| Wildcat | 88 |
| Clapper Rail | 0 |

*Estimate of potential. Bear hunting currently prohibited by statute.

# PASQUOTANK COUNTY



## PENDER COUNTY

### Wildlife

A moderate deer herd occurs throughout the county and a high population occurs on the Holly Shelter Game Land and on the hunting club lands which are adjacent to it. A moderate and stable bear population is present, primarily in that part of the county east of the Northeast Cape Fear River, and a number of bears are taken by hunters each year. The relative stability of this population is strongly related to the presence of the 48,000-acre Holly Shelter Bear Sanctuary. A small population of wild turkeys exists along the Northeast Cape Fear River and in a few other locations. All small game species occur. Squirrel, quail, woodcock, snipe, raccoon and opossum are present in ample number, however, rabbits and doves are not as abundant as in most other coastal counties. Foxes and wildcat are common. The clapper rail is common in tidal marshes, but limited hunting is done for them. Raccoon, otter, and beaver are common, however, the muskrat is absent along the coast and not as common inland as in most other coastal counties. The primary waterfowl species is the wood duck; other species, primarily mallard, occur in limited numbers. Very few Canada geese are present along the coast.

### Fish

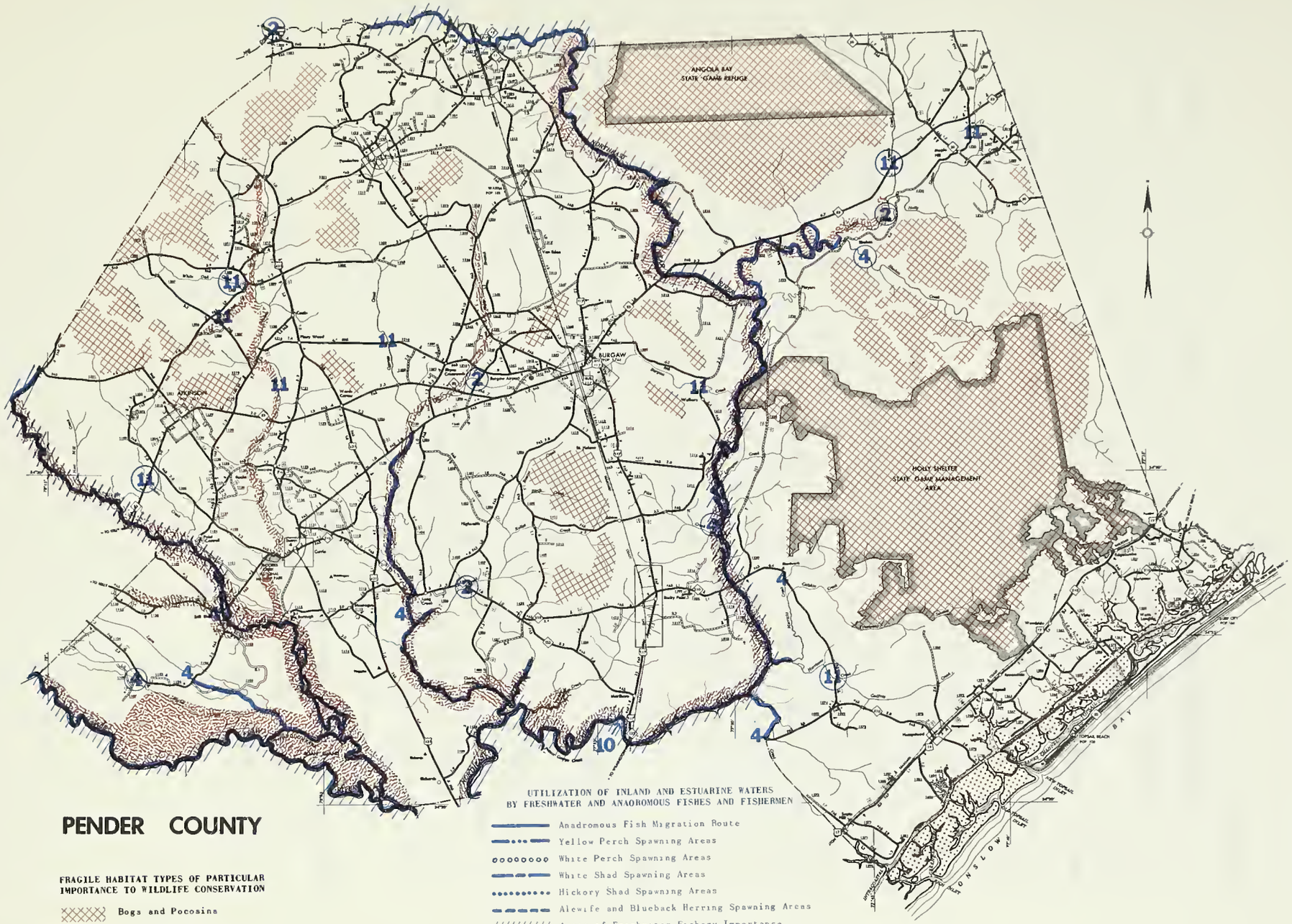
While licensed fishermen express a preference for catching largemouth bass, this species comprises only about two percent of the total catch. Bluegill and redbreast make up about 48 percent of the catch, with white perch, catfish and other panfish making up an additional 35 percent; shad, pickerel and crappie each comprise about three percent or less. Unlicensed fishermen indicate a high preference for bluegill and redbreast.

### Rare and Endangered Species

The American alligator, red-cockaded woodpecker and probably the loggerhead turtle and Atlantic sturgeon occur as endangered species.

PENDER COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 53,875 |
| Bear | 700 |
| Turkey | 32 |
| **Waterfowl** | |
| Ducks | 616 |
| Geese | 198 |
| **Other Game** | |
| Squirrel | 4,636 |
| Rabbit | 5,665 |
| Dove | 936 |
| Quail | 4,437 |
| Raccoon | 10,175 |
| Fox | 1,086 |
| Woodcock | 1,217 |
| Opossum | 4,372 |
| Wildcat | 336 |
| Clapper Rail | 152 |




# PENDER COUNTY

FRAGILE HABITAT TYPES OF PARTICULAR IMPORTANCE TO WILDLIFE CONSERVATION

- Bogs and Pocosins
- Wooded Swamp
- Regularly and Irregularly Flooded Salt Marsh
- Shallow Fresh Marsh

UTILIZATION OF INLAND AND ESTUARINE WATERS BY FRESHWATER AND ANADROMOUS FISHES AND FISHERMEN

- Anadromous Fish Migration Route
- Yellow Perch Spawning Areas
- White Perch Spawning Areas
- White Shad Spawning Areas
- Hickory Shad Spawning Areas
- Alewife and Blueback Herring Spawning Areas
- Areas of Freshwater Fishery Importance
- 3 Ecological Type Classification (See Table VIII)
- (3) Circled Number Indicates Favored Fishing Water

## PERQUIMANS COUNTY

### Wildlife

A high deer population exists throughout all of the county, and either-sex hunting seasons have been scheduled to allow increased harvest. A remnant bear population still occurs in a small area of wooded swamp north of Chapanoke. Bear hunting is prohibited by law. All small game species occur in adequate numbers, including squirrel, rabbits, quail, dove, woodcock, snipe, raccoon and opossum. Foxes are common; wildcat are scarce. Muskrat, raccoon and mink are the common furbearers and few otter occur along the Perquimans River. The wood duck is the waterfowl species present in greatest numbers; however, a mixture of other ducks utilize the shallow shoals at the mouth of the Perquimans River. This area is also utilized by a moderate sized flock of Canada geese. Both ducks and geese also feed in the agricultural fields near Durant's Neck and Harvey Point.

### Fish

Bluegill, white perch and other panfishes such as the warmouth and flier comprise over 70 percent of the catch. Catfish, crappie and redbreast are next in fisherman-take. Largemouth bass, although it ranks first in preference as a game fish, comprises only about four percent of the catch, while striped bass makes up only about three percent.

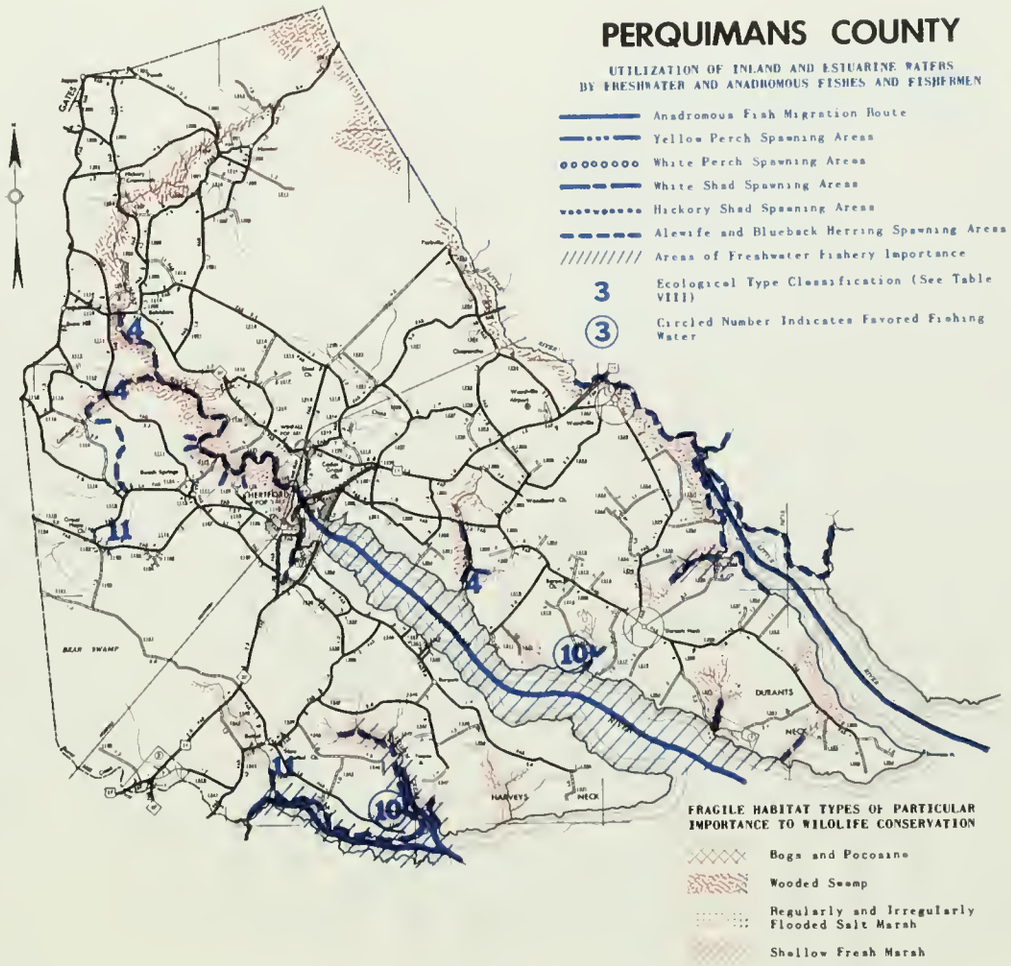
### Rare and Endangered Species

The red-cockaded woodpecker and possibly the short-nose and Atlantic sturgeons occur as endangered species.

## PERQUIMANS COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 23,759 |
| Bear | 100* |
| Turkey | 0 |
| **Waterfowl** | |
| Ducks | 616 |
| Geese | 1,650 |
| **Other Game** | |
| Squirrel | 2,210 |
| Rabbit | 4,280 |
| Dove | 748 |
| Quail | 28,612 |
| Raccoon | 6,933 |
| Fox | 827 |
| Woodcock | 347 |
| Opossum | 2,288 |
| Wildcat | 168 |
| Clapper Rail | 0 |

*Estimate of potential. Bear hunting currently prohibited by statute.


PERQUIMANS COUNTY
UTILIZATION OF INLAND AND ESTUARINE WATERS
BY FRESHWATER AND ANADROMOUS FISHES AND FISHERMEN
Anadromous Fish Migration Route
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FRAGILE HABITAT TYPES OF PARTICULAR
IMPORTANCE TO WILDLIFE CONSERVATION
Bogs and Pocosins
Wooded Swamp
Regularly and Irregularly Flooded Salt Marsh
Shallow Fresh Marsh
BEAR SWAMP
DURANTS
NECK
HARVEYS
NECK

## TYRRELL COUNTY

### Wildlife

A moderate population of the white-tailed deer occurs throughout the county, and a relatively high number of black bear is present in the dense swampland in the vicinity of NC 94 between Kilkenny and Columbia. Most of the county is considered to be suitable bear habitat. Currently, however, large acreages of forested lands are being cleared for agricultural purposes. This practice will seriously reduce the carrying capacity of the cleared areas for the black bear. Hunting for bear is presently prohibited by county law. All small game species are present, including quail, squirrel, rabbits, dove, woodcock, snipe, raccoon and opossum. Highest populations are found in those portions of the county which contain agricultural lands. Wildcat and foxes are common. Mink, raccoon and otter are common furbearers; muskrats, however, are not as abundant as in other counties in the northern Coastal Plain. The higher populations occur in drainage ditches. Waterfowl do not occur in large numbers. Some wood ducks are present throughout the county, and small numbers of several other species of ducks occupy the Alligator River and Albemarle Sound. A moderate population of Canada geese is present on these larger bodies of water.

### Fish

Bluegill, white perch and other panfishes such as the warmouth and flier comprise over 70 percent of the catch. Catfish, crappie and redbreast are next in fisherman-take. Largemouth bass, although it ranks first in preference as a game fish, comprises only about four percent of the catch, while striped bass makes up only about three percent.

### Rare and Endangered Species

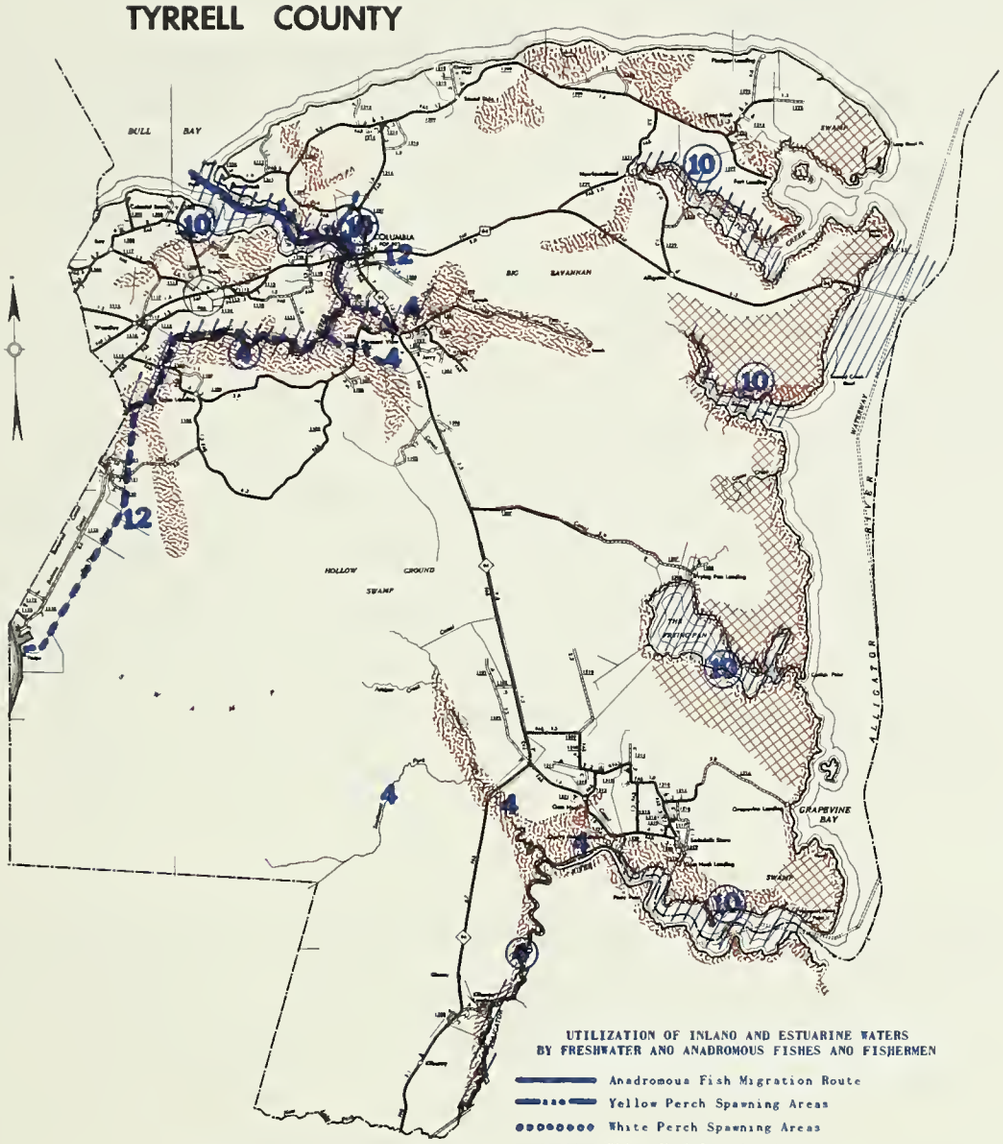
The American alligator occurs along the Alligator River. Proximity to Albemarle Sound would indicate that the Atlantic and shortnose sturgeons occur. There are no recent records for the bald eagle; however, it has been reported for adjacent Hyde and Washington counties. Habitat for the eagle appears suitable.

## TYRRELL COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 29,416 |
| Bear | 1,100* |
| Turkey | 0 |
| **Waterfowl** | |
| Ducks | 462 |
| Geese | 5,500 |
| **Other Game** | |
| Squirrel | 1,973 |
| Rabbit | 4,784 |
| Dove | 760 |
| Quail | 326 |
| Raccoon | 13,780 |
| Fox | 1,720 |
| Woodcock | 1,311 |
| Opossum | 4,548 |
| Wildcat | 200 |
| Clapper Rail | 0 |

*Estimate of potential. Bear hunting currently prohibited by statute.

# TYRRELL COUNTY




**UTILIZATION OF INLAND AND ESTUARINE WATERS BY FRESHWATER AND ANADROMOUS FISHES AND FISHERMEN**

- Anadromous Fish Migration Route
- Yellow Perch Spawning Areas
- White Perch Spawning Areas
- White Shad Spawning Areas
- Hickory Shad Spawning Areas
- Alewife and Blueback Herring Spawning Areas
- Areas of Freshwater Fishery Importance
- 3 — Ecological Type Classification (See Table VIII)
- (3) — Circled Number Indicates Favored Fishing Water

**FRAGILE HABITAT TYPES OF PARTICULAR IMPORTANCE TO WILDLIFE CONSERVATION**

- Bogs and Pocosins
- Wooded Swamp
- Regularly and Irregularly Flooded Salt Marsh
- Shallow Fresh Marsh

## WASHINGTON COUNTY

### Wildlife

Abundant numbers of deer are present throughout the county and a very high population occurs in the south-central portion, particularly in the vicinity of Pungo Lake. The black bear is still present in moderate numbers, but its distribution is recognized to be primarily in the densely vegetated woodlands in the central and southeastern portions of the county. Bear hunting is currently prohibited by county law. Foxes and wildcat are common. All small game species are present in abundance, including quail, squirrel, rabbits, dove, woodcock, snipe, raccoon and opossum. The primary furbearers are muskrat, raccoon, mink and otter, all of which are present in adequate numbers. In total numbers of waterfowl present, Washington County is exceeded only by Currituck and Hyde. The Pungo National Waterfowl Refuge winters thousands of Canada geese and ducks, however, the wood duck is abundant throughout the county and other species are common on Lake Phelps, Albemarle Sound and in the timbered wetlands found along the Roanoke River and other watercourses.

### Fish

Bluegill, white perch and other panfishes such as the warmouth and flier comprise over 70 percent of the catch. Catfish, crappie and redbreast are next in fisherman-take. Largemouth bass, although it ranks first in preference as a game fish, comprises only about four percent of the catch, while striped bass makes up only about three percent.

### Rare and Endangered Species

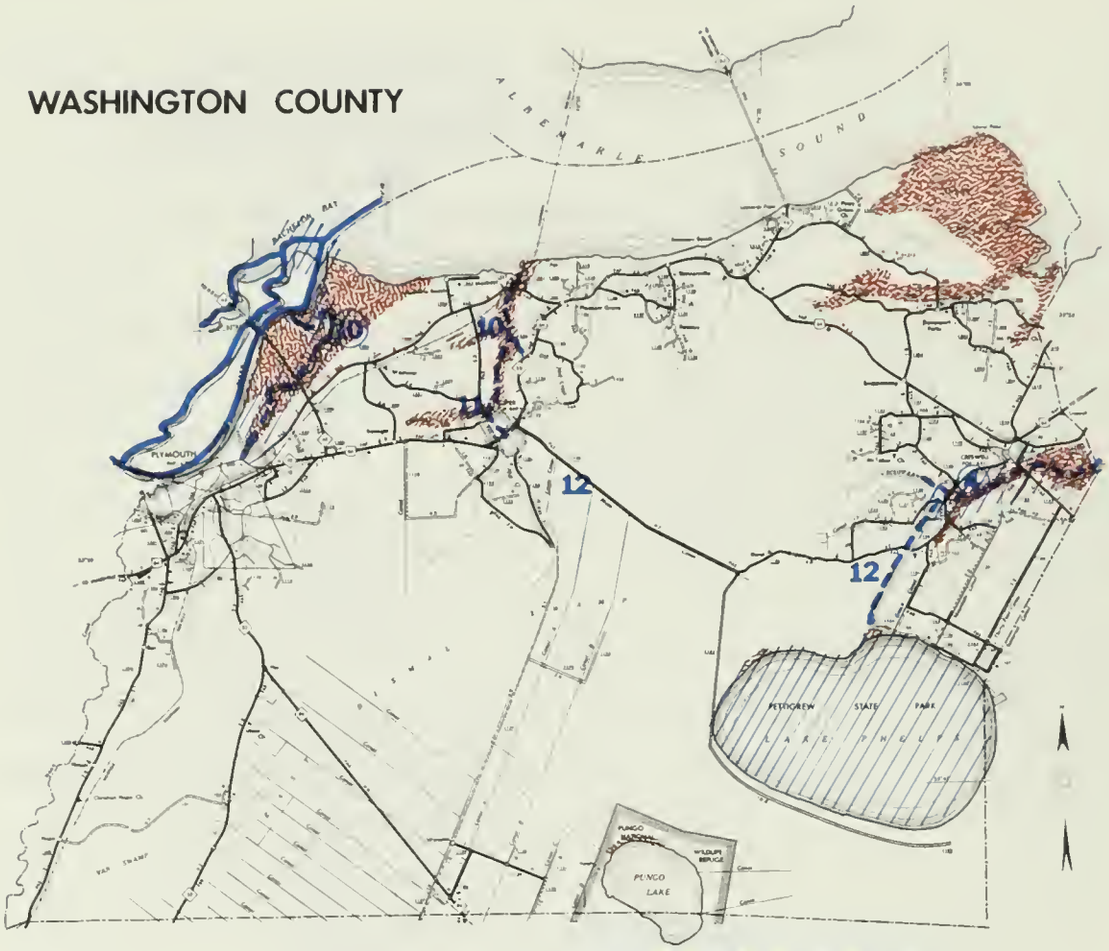
The bald eagle has been reported as recently as February and April 1973. Other endangered species that probably occur are the Atlantic and short-nose sturgeons.

## WASHINGTON COUNTY

| GAME SPECIES | ESTIMATED MAN DAYS OF RECREATIONAL PURSUIT PROVIDED (1972-73) |
|---|---|
| **Big Game** | |
| Deer | 31,613 |
| Bear | 700* |
| Turkey | 0 |
| **Waterfowl** | |
| Ducks | 4,990 |
| Geese | 42,050 |
| **Other Game** | |
| Squirrel | 1,813 |
| Rabbit | 2,178 |
| Dove | 449 |
| Quail | 1,480 |
| Raccoon | 5,805 |
| Fox | 556 |
| Woodcock | 945 |
| Opossum | 1,614 |
| Wildcat | 96 |
| Clapper Rail | 0 |

*Estimate of potential. Bear hunting currently prohibited by statute.

# WASHINGTON COUNTY

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- Bogs and Pocosins
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